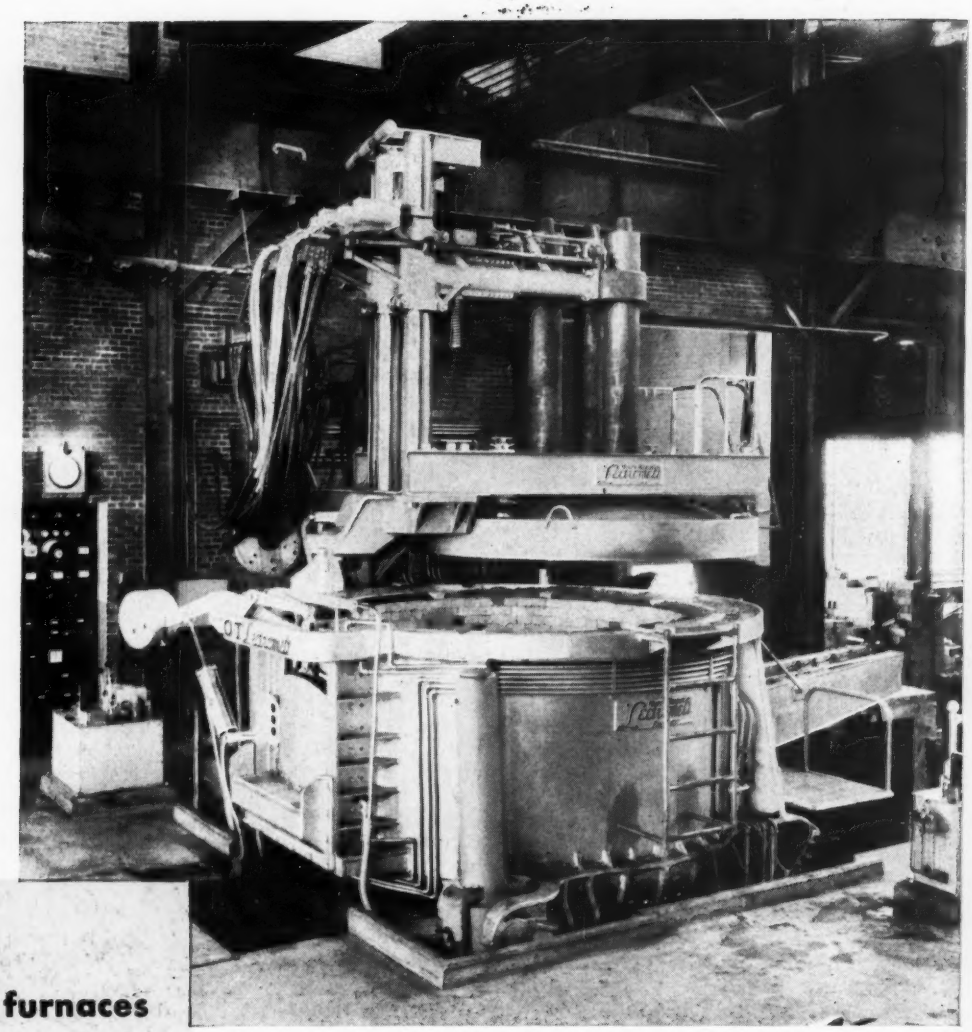
PUBLIC LIBRARY
FEB 21 1948
DETROIT

FEBRUARY 1948

American Foundryman

the Foundrymen's OWN *Magazine*



in metal melting furnaces

Control Counts

MOORE RAPID
Lectromelt
FURNACES

Manufactured in

ENGLAND	**Birlec, Ltd., Birmingham**
FRANCE	**Stein et Roubaix, Paris**
SPAIN	**General Electrica Espanola, Bilboa**
BELGIUM	**S. A. Belge Stein et Roubaix, Bressoux-Liege**

The quality of the iron or steel you produce—and the ease and economy with which you produce it—depend to a large extent upon the performance of your furnace controls. When you use Lectromelt furnaces you're using the best in precise automatic regulation.

Lectromelt's Patented counter-balanced electrode arm control system gives you precise, consistent furnace regulation with the utmost economy. Employing a patented friction bite winch system actuated by the most sensitive automatic controls results in the most rapid and economic operation.

Write today for full details of Lectromelt furnaces and their control system.

PITTSBURGH..30,..PENNA.

TECHNOLOGY DEPART...

CROWN HILL

...LIBRARY
FEB 29 1948
DETROIT

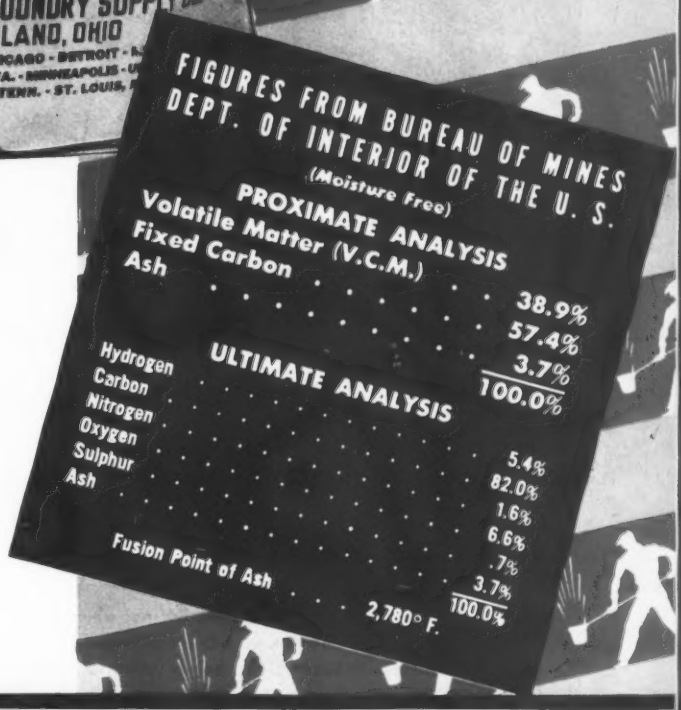
MORE...

MORE, MORE AND MORE...

FOUNDRYMEN CHOOSE

CROWN HILL

SEACOAL



The Seacoal of Accepted Reliability

What makes Crown Hill such a popular seacoal?

Quality . . . Crown Hill's high volatile induces quick combustibility, quicker escape of gas and steam, better finish, lower cleaning costs, fewer defects.

Popularity . . . Foundrymen far and wide have used Crown Hill for many years. They know by experience how good Crown Hill really is.

Manufacturer . . . Made by the friendly friend of the foundries, The Federal Foundry Supply Co., a good company with which to do business.

Test Crown Hill Seacoal Facing in your foundry.

THE FEDERAL FOUNDRY SUPPLY COMPANY

4600 East 71st Street · Cleveland 5, Ohio

Seacoal Plant: CROWN HILL, W. VA. · CHICAGO · CHATTANOOGA, TENN. · DETROIT · MILWAUKEE · NEW YORK · ST. LOUIS · RICHMOND, VA. · Mines: UPTON, WYO.

IN TWIN CITIES: The Foundry Supply Co., Inc., 404 South Third St., Minneapolis 15, Minn. IN SOUTHWEST: Beaumont Cement Sales Co., Houston & Beaumont, Texas, and Harvey, La.

...for sand handling equipment in modern aluminum foundry!

SAND IN ITS PLACE is alright, but not when it floats in your plant . . . falling on valuable equipment . . . causing wear and health hazards. In modern foundries, like that of Nylen Products Co., St. Joseph, Michigan, the dust raised by sand handling equipment is put in its place by a KIRK & BLUM Dust Collecting System.

Nylen Products Co. manufacturers of aluminum pistons and pins, uses large amounts of sand in the casting processes. The photo looking up into the sand tower shows the streamlined type Kirk & Blum fittings which promote top efficiency in air and dust handling.

The experience of more than 40 years and the talents of many engineers go into the design and installation of every KIRK & BLUM System. KIRK & BLUM Engineers will gladly provide an expert, no-obligation survey of your dust collecting problems and needs. Write for Descriptive Booklet M, "Dust Collecting Systems in Metal Industries."
The Kirk & Blum Mfg. Company, 2876 Spring Grove Ave., Cincinnati 25, Ohio.

FOR CLEAN AIR... THE INVISIBLE TOOL

KIRK AND BLUM

DUST CONTROL SYSTEMS

A.F.A.
NATIONAL OFFICERS

PRESIDENT
*Max Kuniansky
Lynchburg Foundry Co.,
Lynchburg, Va.

VICE-PRESIDENT
*W. B. Wallis
Pittsburgh Lectromelt Furnace Corp.
Pittsburgh, Pa.

NATIONAL DIRECTORS

Term Expires 1948

R. R. Gregg
Reliance Regulator Corp.
Alhambra, Calif.

E. W. Horlebein
Gibson & Kirk Co.
Baltimore, Md.

H. H. Judson
Worcester, Mass.

*Jas. H. Smith
Central Foundry Div.
General Motors Corp.
Saginaw, Mich.

F. M. Wittlinger
Texas Electric Steel Casting Co.
Houston, Texas

*S. V. Wood
Minneapolis Electric Steel Castings Co.
Minneapolis

Term Expires 1949

H. G. Lamker
Wright Aeronautical Corp.
Woodridge, N.J.

B. L. Simpson
National Engineering Co.
Chicago

H. A. Deane
American Brake Shoe Co.
Brake Shoe & Castings Div.
New York

*S. C. Wasson
National Malleable & Steel
Castings Co.
Chicago

J. E. Kolb
Caterpillar Tractor Co.
Peoria, Ill.

Term Expires 1950

E. N. Delahunt
Warden King, Ltd.
Montreal, Quebec, Canada

W. J. MacNeill
G. H. R. Foundry Div.
Dayton Malleable Iron Co.
Dayton, Ohio

*J. M. Robb, Jr.
Hickman, Williams & Co.
Philadelphia

A. C. Ziebell
Universal Foundry Co.
Oshkosh, Wis.

R. H. McCarroll
Ford Motor Co.
Dearborn, Mich.

*Member, Executive Committee

A.F.A. HEADQUARTERS
222 WEST ADAMS ST., CHICAGO 6

Wm. W. Maloney, *Secretary-Treas.*
S. C. Massari, *Technical Director*
H. F. Scobie, *Educational*
Jos. E. Foster, *Technical*
A. A. Hilbron, *Convention & Exhibits*
G. R. Buhler, *Editorial*
C. R. McNeill, *Editorial*
John D. Murray, *Advertising*
Terry Koeller, *Promotion*
G. A. Whittington, *Staff Asst.*

CONTENTS

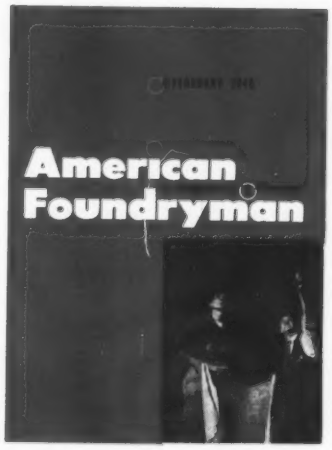
21 Shortage of Melting Stock in Malleable Castings Industry: L. J. Wise
22 1948 Program and Exhibit Geared to Industry Progress
27 Engineering for Aluminum Alloy Castings: T. R. Gauthier and H. J. Rowe
37 Synthetic Resin Binders: H. C. Frisbie
41 Acicular Cast Irons: Committee Report, The Institution of Mechanical Engineers, London
50 Malleable Sand Control: David Tamor
52 Modern Foundry Theory for the Patternmaker: E. J. McAfee and R. G. Wagner
58 Color Conditioning Pays Off
60 Pressure Feeding of Steel Castings: W. T. W. Shute
63 Management's Stake in Personnel Training: Ralph L. Lee
65 New A.F.A. Members
68 Foundry Personalities
70 Chapter Activities
73 Chapter Meetings, February–March
78 February Who's Who
86 Foundry Firm Facts
88 New Foundry Literature

VOLUME XIII, NUMBER 2

American Foundryman

February, 1948

Official publication of American Foundrymen's Association

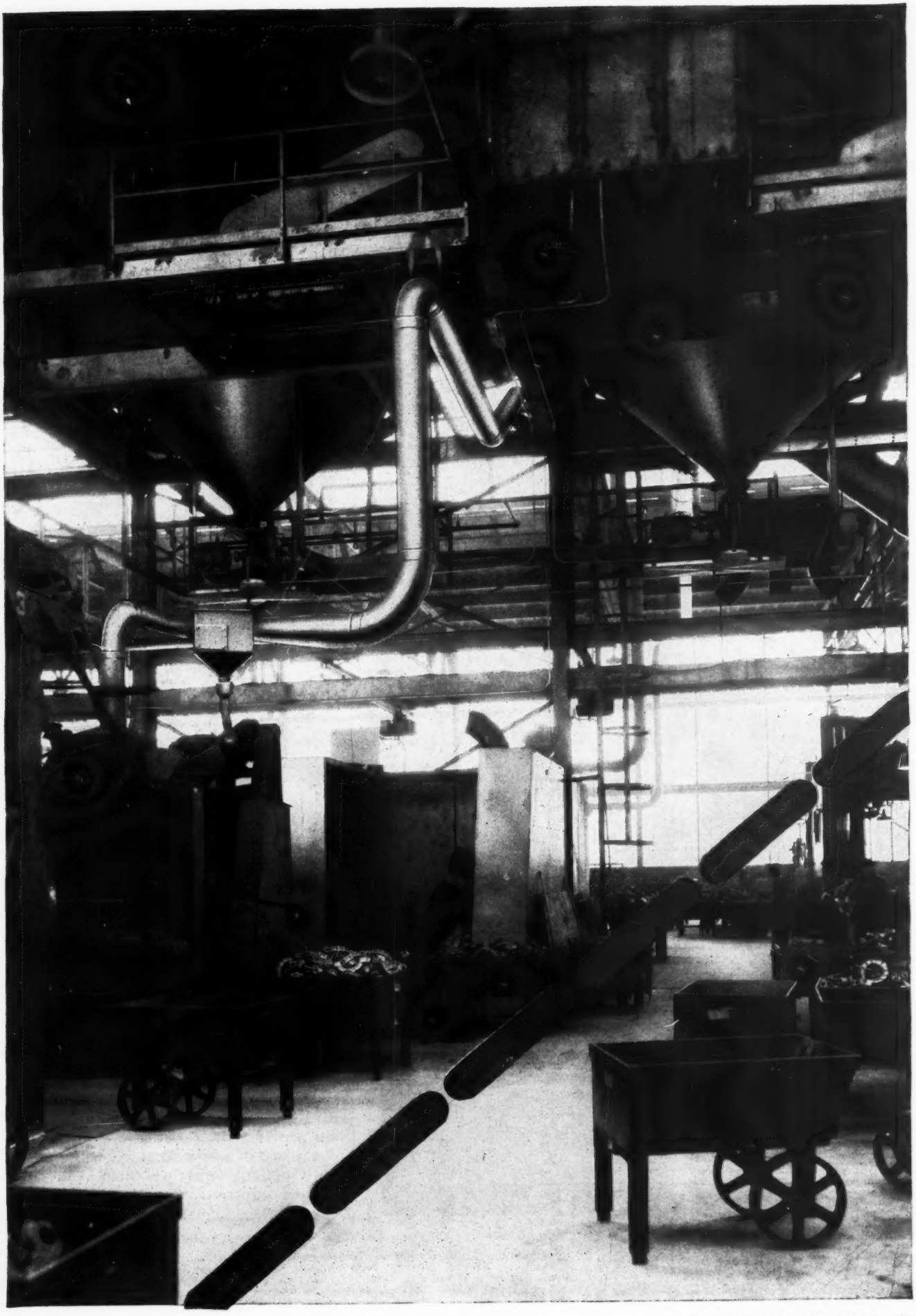


The American Foundrymen's Association is not responsible for statements or opinions advanced by authors of papers printed in its publication.

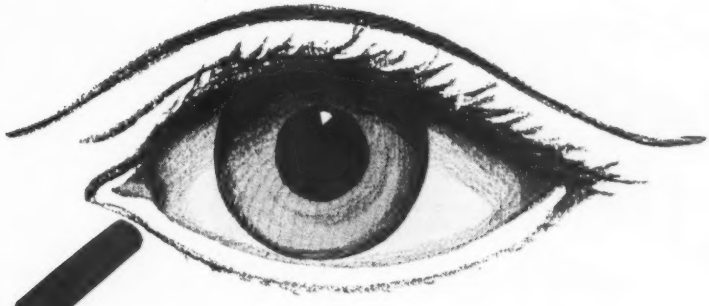
This Month's Cover

Plant superintendent directing a program of modernization and preventive maintenance, including a complete paint job. A carefully planned and executed program provides the foundry worker with a better place in which to work—a long step toward better worker relations—and is a tangible production aid (see p. 58, this issue).

Published monthly by the American Foundrymen's Association, Inc., 222 W. Adams St., Chicago 6. Subscription price, to members, $4.00 per year; to non-members, $6.00 per year. Single copies, 50c. Entered as second class matter July 22, 1938, under the Act of March 3, 1879, at the post office, Chicago, Illinois. Additional entry at Ann Arbor, Mich.



THERE'S MORE THAN MEETS THE *EYE*...



In a Schneible Foundry Dust Collection System...

The photograph shows two Schneible Multi-Wash Collectors, overhead, serving abrasive blast cleaning and grinders. You can see the cleanliness of the department which permits location of the following sizing and straightening press operation without separating walls; you can see the wide open sweep through the foundry with no complicated network of pipes and plenty of head room and floor space.

You Can't See the under-floor exhaust system whisking dust and contamination to the collectors or the centralized Velocitrap that eliminates individual drop out boxes and requires only periodic emptying.

You Can't See the vibration-free, positive action within the collectors as the contaminated air whirls up through the impingement stages and into turbulent contact with the gravity fed wash water. All dust, odor, and fumes are flooded out for easy disposal. There are no moving parts to wear or clog . . . and the exhaust fan is on the clean air side for maximum service life. Ductwork can be connected to any side and to as many inlets as required to eliminate concentration in one header.

You Can't See the "closed circuit" system whereby all material flows as disposable sludge from the bottom of the collector to a Schneible Dewatering System so that water is reclaimed for re-use.

You Can't See the constant volume of air being moved with a very minimum expenditure of horsepower and minimum maintenance and care that gives you, at lowest possible cost, a clean, safe place for men to work.

You Can't See the more than 30 years of engineering experience that gives Schneible the "know how" to solve any foundry dust collection problem with a system that can be installed without disrupting present plant layout or production . . . a system that has, in every type of foundry, stood the test of time.

You Can See **the results when a Schneible Dust Collecting System brings you a dust; odor; and fume-free foundry, and you watch production figures jump and costs drop. Send for Bulletin 47, "Schneible in the Foundry Industry."**

MANUFACTURER'S ASSOCIATION, INC. FOUNDRY EQUIPMENT

Engineering Representatives in Principal Cities

CLAUDE B. SCHNEIBLE CO.

2827 Twenty-Fifth St. • Detroit 16, Mich.

SCHNEIBLE

LIQUID-VAPOR INTIMATE CONTACT EQUIPMENT for DUST COLLECTION ABSORPTION CONDENSATION AND TEMPERATURE REDUCTION

To Improve Your Castings ~~

ADD ONE BRICK OF

Famous CORNELL CUPOLA FLUX

TO EACH TON CHARGE OF IRON (Under Average Conditions) OR BREAK OFF A QUARTER SECTION FOR EACH 500 LB. CHARGE.

It purifies metal, makes it hotter and more fluid.

Famous Cornell Cupola Flux causes rapid elimination of slag and other impurities from molten metal, aids greatly in reducing sulphur—definitely improves metal structure.

Famous Cornell fluxed metal results in castings that are denser grained, stronger—chilled sides, hollow centers, are greatly reduced, so are rejects and make-overs. Machining is easier. Cupolas are kept cleaner—maintenance low.

Famous Cornell Cupola Flux comes to you in pre-measured Scored Brick form, requires but a few seconds to flux a charge of iron correctly—and the cost is negligible compared with the results.

Write for Bulletin 46-B

The CLEVELAND FLUX Company

1026-1034 MAIN AVENUE, N. W., CLEVELAND 13, OHIO

Manufacturers of Iron, Brass and Aluminum Fluxes Since 1918

FAMOUS FLUXES
Trade Mark Registered

Write for Bulletins

Famous CORNELL ALUMINUM FLUX	Famous CORNELL BRASS FLUX	Famous CORNELL LADLE FLUX
Produces clean, tough castings. No spongy or porous spots even when more scrap is used. Thinner yet stronger sections are poured. Castings take a higher polish. NO FUMES! Exclusive formula prevents obnoxious gases. Metal does not cling to dross.	Makes metal pure and clean, even when dirtiest brass turnings or sweepings are used. Produces castings which withstand high pressure tests and take a beautiful finish. Saves considerable tin and other expensive metals. Crucible and furnace linings are preserved.	Place a few ounces in bottom of ladle, then tap cupola. Metal is thoroughly cleansed, foreign impurities are easily skimmed off. Ladles are kept clean, there is less patching and increased ladle life. Metal temperatures are retained during transfer to molds.

"take it" from Chief Keokuk...

"Blue Ribbon" Winner

... that's KEOKUK Electro-Silvery

STEEL PLANTS

60-pound Keokuk Electro-Silvery Pigs for blocking the open hearth heat. For equal distribution of silicon and best temperature melt-down. Handle by magnet.

FOUNDRIES

30-pound Keokuk Electro-Silvery Pigs for charging mechanically or by hand into the cupola. Easily broken into two or more pieces, handled by magnet and measured by weight. Regular or alloy analysis.

12½-pound Keokuk Electro-Silvery Piglets so uniform in weight that they may be charged into the cupola by count, eliminating weighing operations. Handle by magnet. Regular or alloy analysis.

Write today for complete information.

KEOKUK ELECTRO-METALS COMPANY

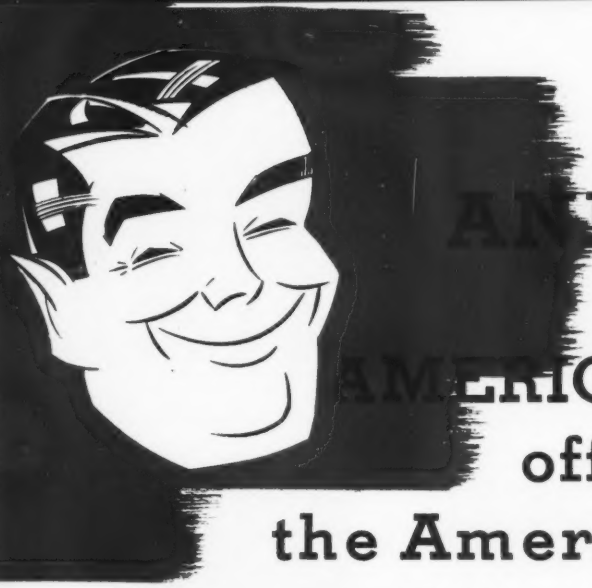
KEOKUK, IOWA

Sales Agents: MILLER AND COMPANY, 332 S. MICHIGAN AVENUE, Chicago 4, Illinois
CINCINNATI 2, OHIO, 3504 CAREW TOWER • ST. LOUIS 1, MISSOURI, 407 N. EIGHTH ST.

1948 Foundry Congress and Show May 3-7, 1948

WILL TAKE FOUNDRY MARKET TO

Philadelphia



AND . . . the Convention Issues of AMERICAN FOUNDRYMAN, official publication of the American Foundrymen's Association, will record events of this 52nd Annual Meeting in print.

April Pre-Convention Issue **will contain the official convention program . . . it will be a "preview" of events to come . . . it will reach your best prospects and customers before they leave for the congress . . . it will have distribution at this important national meeting to be held in Philadelphia, May 3-7, 1948, inclusive.**

May Post-Convention Issue **will record the events of the annual convention . . . it will reach your best prospects and customers at their homes just long enough after their return to make a review of convention highlights a welcome reminder of new products, new procedure, new developments . . . it will be a timely approach to an alert market.**

Philadelphia, one of the leading foundry centers, offers many inducements, both historical and industrial, to forecast a meeting that will feature the most modern foundry equipment and supplies, engineering principles and processes. Exhibits and technical sessions alike will show trends that reflect the newest developments in cast products, with adaptability hinging on the fabricators' skill in meeting factors of economy, design and utility.

However, limited time at the convention will make it possible to only cover direct foundry processes at the various technical sessions, *but advertisers in the Official Convention Issues may deal with every phase of Production, Machining and Finishing of castings.* AMERICAN FOUNDRYMAN Convention Issues provide direct contact between seller and buyer at convention time. Both Convention Numbers will carry a wealth of practical and technical articles on reports of AFA committee functions . . . news of AFA Chapters . . . a Buyers' Guide . . . and enlarged advertising sections.

As the established technical magazine of the foundry field, the AMERICAN FOUNDRYMAN is an accepted medium in a world market. Give your sales force the benefit of a consistent AMERICAN FOUNDRYMAN campaign, and let your message in the Official Convention Issues tie in with a regular schedule of advertisements in *"The Foundryman's Own Magazine."* THERE WILL BE NO INCREASE IN CONVENTION ISSUE ADVERTISING RATES.

★

American Foundrymen's Association

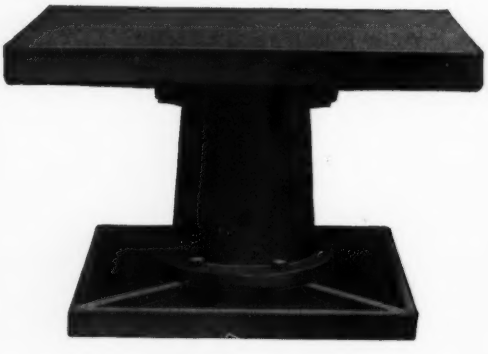
222 WEST ADAMS ST.
CHICAGO 6, ILLINOIS

"All Federal Products

FEDERAL

FEDERAL'S LOWE SIFTER

Save money by faster sifting, better sand conditioning with a Lowe Electric Sifter. Features: greater screening area, enclosed ball bearing motor, more shoveling room. Write for information. Prompt delivery.



FEDERAL JOLT MACHINES

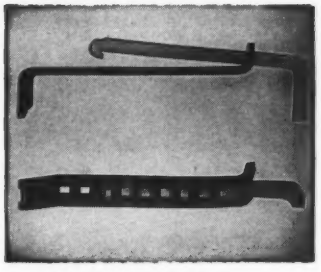
Air operated, fool-proof jolt machines that ensure uniform cores. Sturdy cast iron construction with no external valves to wear out. Made in four sizes. Get our prices and deliveries.

RUBBER-COVERED SHOVEL HANDLES

The best insurance you can buy against damaged patterns, core boxes or flasks. The pean-shaped grip is ideal for ramming.

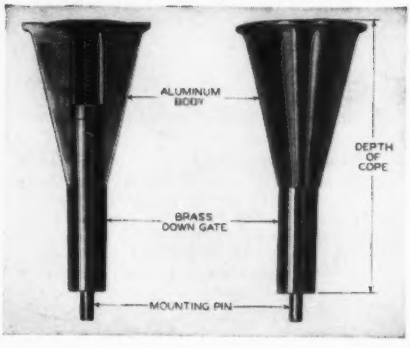
They will fit your present shovels or you can order your next shovels with them already installed.

The "Lightning" Clamp



The "Holdtite" Clamp

Federal offers two types of flask clamps.
The "Lightning" clamp is an eccentric type, requiring no wedges and available in two sizes: No. 2, 8" to 12" and No. 3, 12" to 20".
The "Holdtite" is an adjustable clamp designed for use with wedges and is also offered in two sizes: No. 1, 15" to 23" and No. 0, 18" to 33".
Both clamps made of sturdy malleable iron, rigidly reinforced to prevent distortion.



SHUR-SPOT SPRUE

Designed for use on squeezer-made molds, Shur-Spot squeezes right down with the sand. When the squeezer board is removed, the Shur-Spot pops up and can be lifted right out. The result is a fully completed and properly located pouring sprue that requires no finishing. Shur-Spot Sprue eliminates danger of falling sand.
For complete information on the Shur-Spot Sprue, write for the circular on this low-priced, easy-to-use item.

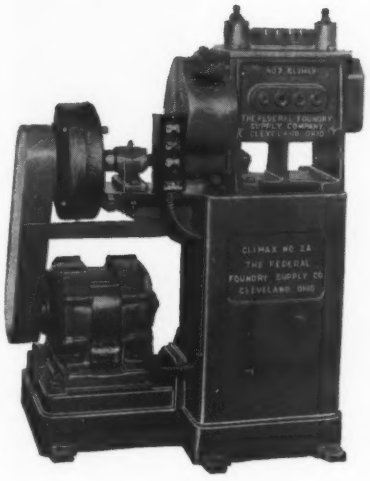
THE FEDERAL FOUNDRY

Seacoal Plant
CROWN HILL, W. VA. · CHICAGO · MILWAUKEE · DETROIT · ST. LOUIS

Chamberlain Co., Los Angeles, Calif. · Pacific Graphite Works, Oakland, Calif. · LaGrand Industrial Supply Co., Portland, Ore.

Are Sold with Service"

SUPPLIES

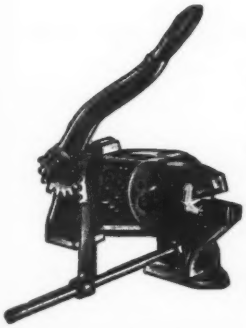


CLIMAX WIRE STRAIGHTENERS

Any foundry, large or small, can cut production costs by straightening and re-using core wires and rods. With a Climax Wire Straightener this can be done quickly, economically, safely – by unskilled labor. A complete descriptive circular is yours for the asking.

TWISTED STEM CHAPLETS

The chaplet with everything. The "Twisted Stem" promotes rapid complete fusion. Not deformed, the stem has no weak spot to burn in and permit core shift. Made in a complete range of sizes. Samples of the size you use, gladly submitted.

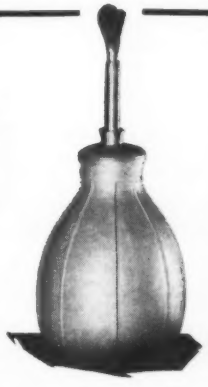


FEDERAL'S WONDER CUTTERS

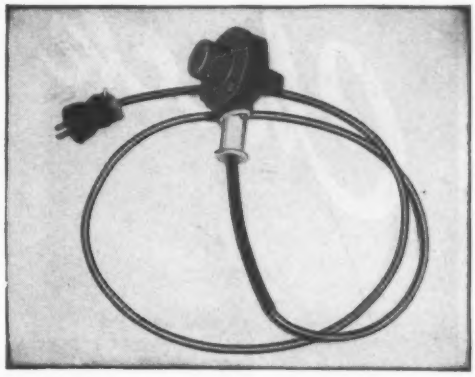
Two compact cutters for rods and band iron. One cuts up to ⅝" round and the other to ⅞" round. Readily mounted on any bench. Users say they're worth their weight in gold!

WATER BRUSH

Easy to Grip and Hard to Tip. It can't leak and one filling lasts all day. Does not tire the molder's hand.



FEDERAL VIBRATOR No. 2 and 5

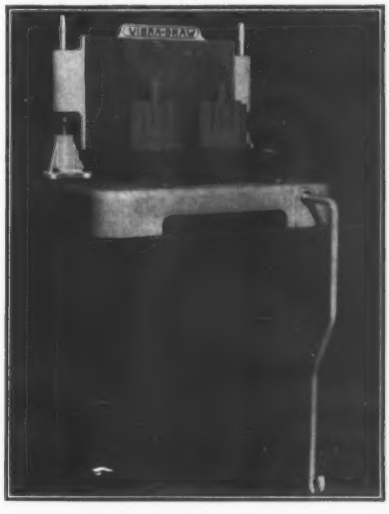


Federal's own make and available for immediate delivery. Hard-chromed piston guarantees long life. For 110 volt, 60 cycle, single phase operation. $15.60 each, f.o.b. Cleveland; No. 5 for heavier duty—$20.40 each.

Federal also has a new "convenience outlet knee switch." No taping, soldering or wiring. Plug in—that's all. Carried in stock. $6.50 each, f.o.b. Cleveland, Ohio.

FEDERAL'S "VIBRA-DRAW" CORE DRAWING MACHINE

Cuts costs in your core room by making it easy for every core maker to draw perfect cores as fast as he can fill the core box, place it against the vibrating head and lift the box. Made in two styles: the floor model and the portable bench model shown below. Immediate delivery—write for details.



SUPPLY COMPANY · 4600 EAST 71st STREET CLEVELAND 5, OHIO

CHATTANOOGA, TENN. · ST. PAUL · NEW YORK · RICHMOND, VA. · UPTON, WYO. Mines

Beaumont Cement Sales Company, Houston and Beaumont, Texas and Harvey, La. · Shanahan's Ltd., Vancouver, B. C.

Check this . . .

IN YOUR FOUNDRY.

"the casting finish is no better than the mold and core surfaces over which the metal flows"

Send for bulletins describing Delta Core and Mold Washes and how to use them in your foundry.

If the mold and core surfaces are rough . . . the casting finish will be equally as rough. Smooth surfaces, having the required physical and chemical characteristics, produce finer-finish castings.

DELTA Core and Mold Washes, products of scientific research, produce slick-smooth mold and core surfaces which are highly refractory and non-reactive with molten metals. When applied to cores and molds they penetrate from 3 to 5 grains deep and, when dry, are thoroughly anchored to the sand surfaces.

Castings made with DELTA washed surfaces are cleaner, smoother and require only a minimum of cleaning room time.

For GREY IRON—Use DELTA GRAKOAT WASH

For MALLEABLE—Use DELTA HI-TEMP WASH

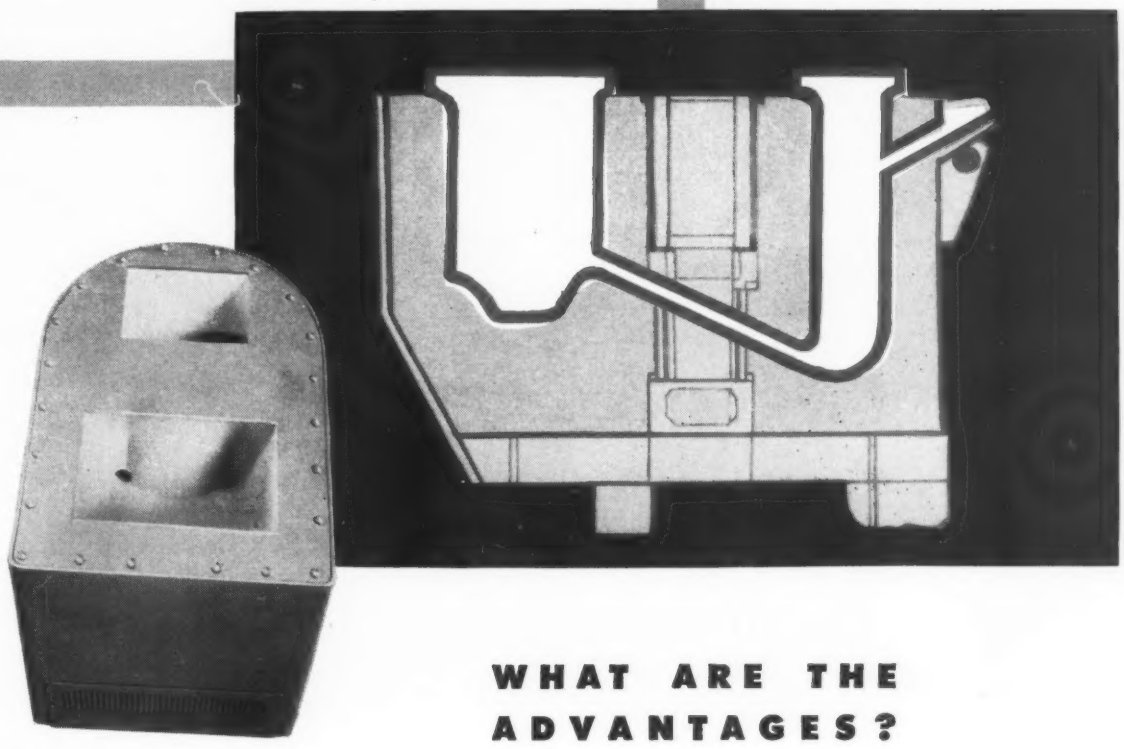
For NON-FERROUS—Use DELTA NON-FERRUSKOAT WASH

Ask for a liberal working sample for test purposes.

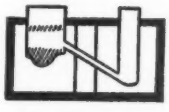
DELTA OIL PRODUCTS CO.

MILWAUKEE 9, WISCONSIN

Why Two Chambers in the *LINDBERG-Fisher* INDUCTION MELTING FURNACE



WHAT ARE THE ADVANTAGES?



Cleaner molten metal. Residue remains in charging chamber—either floating at surface or sinking to bottom. Only clean, residue-free metal passes to second chamber for pouring.

Metal always at pouring temperature. Adding cold metal to charging chamber does not affect temperature in pouring chamber, within reasonable operating limits.

Less scrap loss. Set furnace for a lower maximum casting temperature. Plus or minus 5° F. temperature control eliminates possibility of over- and undershooting.

Easier cleaning. Pouring chamber seldom requires cleaning as only residue-free metal reaches it. Straightline melting channels clean easily.

Less maintenance. Refractory-lined chambers—no crucibles or pots to replace. No burners to clean.

Cooler operation. Induction heating heats metal only, not the entire furnace. Covered chambers prevent heat radiation except when charging or ladling.

Now . . . a complete line of melting furnaces—gas, oil, electric

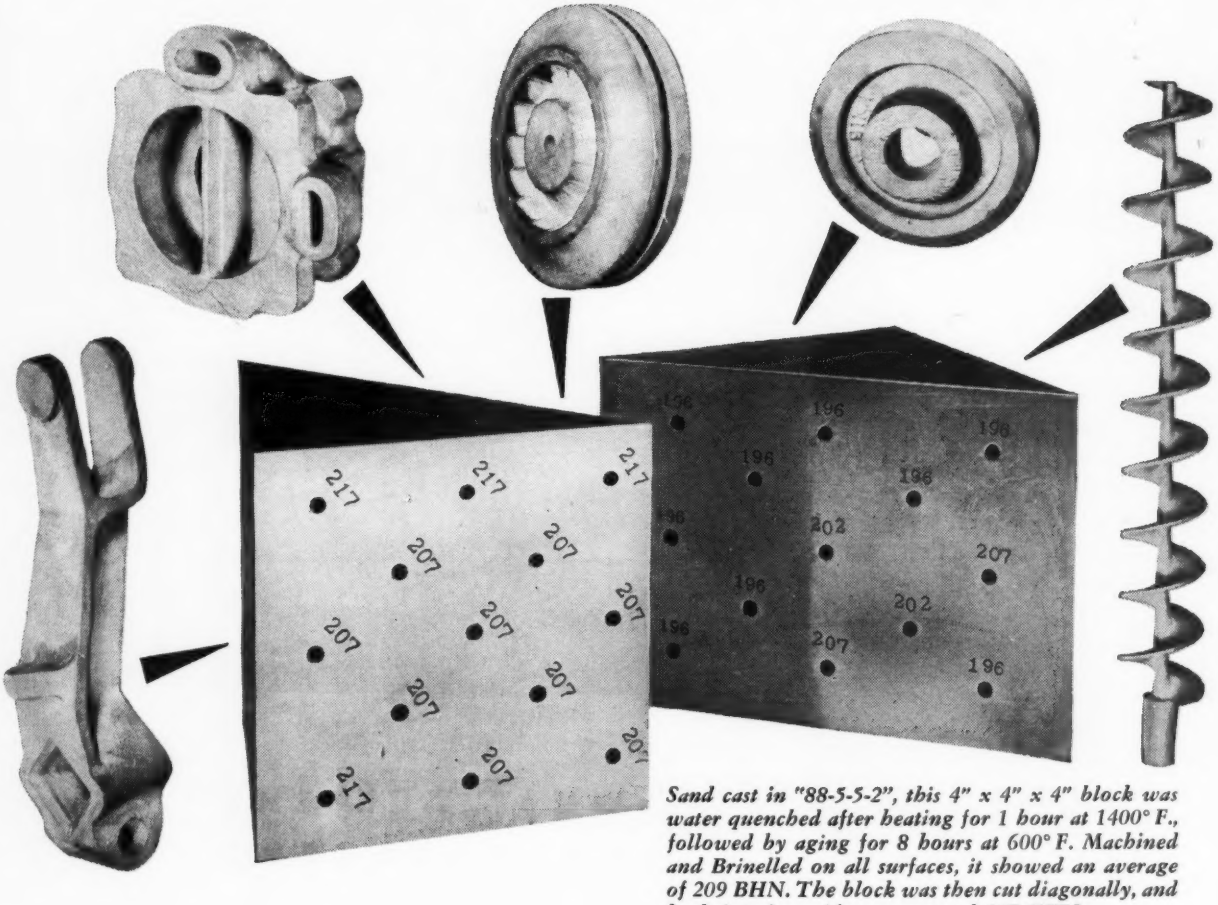
Fisher Furnaces

A DIVISION OF LINDBERG ENGINEERING CO.
2440 WEST HUBBARD STREET • CHICAGO 12, ILLINOIS

AN AGE-HARDENABLE

NICKEL-BRONZE

DEVELOPED FOR HEAVY DUTY SERVICE



Sand cast in "88-5-5-2", this 4" x 4" x 4" block was water quenched after heating for 1 hour at 1400° F., followed by aging for 8 hours at 600° F. Machined and Brinelled on all surfaces, it showed an average of 209 BHN. The block was then cut diagonally, and both interior surfaces averaged 197 BHN.

Specify "88-5-5-2" (Copper-Tin-Nickel-Zinc) where you want corrosion-resistant bronze castings with extremely high mechanical properties.

This alloy in the "as-cast" condition serves the same purposes as "G" Bronze, but that's not the whole story.

The excellent physical properties of "88-5-5-2" may be immensely improved by heat treating . . . as exemplified by the block shown above.

The Nickel content provides the age-hardening response which increases both tensile and compressive strength, being particularly effective in raising the elastic properties. Nickel also increases fluidity in the casting mixture, thus affording a widened casting range that helps to minimize misruns and improves density and pressure-tightness.

This age-hardening Nickel-bronze meets wide demands. Philadelphia Bronze and Brass Corp., maker of the parts illustrated, produces "88-5-5-2" castings that range in size from ½" x 12" bars to parts weighing over 500 pounds.

EMBLEM OF INCO SERVICE
TRADE MARK

Over the years, International Nickel has accumulated a fund of useful information on the selection, fabrication, treatment and performance of engineering alloy steels, stainless steels, cast irons, brasses, bronzes and other alloys containing Nickel. This information is yours for the asking. Write for "List A" of available publications.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

That's where we put our rejects

TRUSCOR (light weight) AMERIKOR (heavy weight) Cereal Binders improve quality of castings and cut down on the number of rejects.

These cereal binders add flowability, texture and green strength. Whether bench made — machine made — or blower made cores, no part is too small or too remote for accuracy.

And because the cereal burns out rapidly and completely during casting, permeability and collapsibility are at once increased to minimize the possibility of blows, cracks, etc.

Specify Krause Cereal Binders on your next order — TRUSCOR, if you like light weight; AMERIKOR, if you prefer the heavy weight.

CHAS. A. KRAUSE MILLING CO., MILWAUKEE 1, WIS.
World's largest millers of dry corn.

CEREAL BINDERS

DISTRIBUTORS

M. A. Bell Co., 3430 Brighton Blvd., Denver, Colo.
M. A. Bell Co., 401 Velasco St. Houston, Texas
M. A. Bell Co., St. Louis 2, Mo.
A. L. Cavedo & Son, Inc. Richmond 21, Va.
Foundry Supplies Co. Chicago 16, Ill.
J. H. Hatten, Lansdowne, Pa.
Independent Foundry Supply Co., Los Angeles 11, Calif.
Joseph B. Meier, 96 N. 18th St., East Orange, N. J.
Marthens & Co., Moline, Ill.
Carl F. Miller & Co. Seattle 4, Wash.
Milwaukee Chaplet & Mfg. Co., Milwaukee 4, Wis.
Pacific Graphite Works Oakland 8, Calif.
Porter-Warner Chattanooga 2, Tenn.
Smith-Sharpe Co. Minneapolis 14, Minn.
Frederic B. Stevens, Inc. Buffalo 12, N. Y.
Frederic B. Stevens, Inc. Cleveland 14, Ohio
Frederic B. Stevens, Inc. Detroit 26, Mich.
Western Industrial Supply Co. 208 S. E. Hawthorne Blvd. Portland 14, Oregon

THE present demand for castings should prompt foundry owners and managers to consider their foundry's production capacity and profit potential in the light of expected future demands. What changes would be necessary in your present facilities, procedures or methods to insure profitable operation at present, lower, or higher production rates?

Quality...
NOT QUANTITY in FOUNDRY ENGINEERING

Whether the requirement is elimination of a single "bottle neck", reorganization of individual departments, installation of cost control, job evaluation, standards, incentives, a complete foundry modernization program, temporary operation or management, or the design of a complete new plant, the job can be successfully accomplished by Lester B. Knight and Associates. A complete survey of your operations by our experienced survey engineers will determine what is required, what it will cost, and how soon you can expect to recover the cost through operational savings.

In the Lester B. Knight & Associates organization there are thirty men, each with ten to twenty-five years of successful foundry management, production, engineering, or equipment experience in all types of foundries. Through their coordinated knowledge and experience Knight can be of inestimable service in analyzing your foundry operations and recommending steps to permit the ultimate objective—maximum production at minimum unit cost.

The Knight organization is large enough to handle the big jobs—small enough to be interested in the small jobs. Quality—not quantity—in Foundry Engineering, is our creed.

KNIGHT Service for Foundries:
- Foundry Engineering
- Architectural Planning
- Foundry Layout
- Foundry Modernization
- Foundry Management
- Industrial Engineering; Job Evaluation, Incentives
- Production and Cost Control

LESTER B. KNIGHT & ASSOCIATES INC.

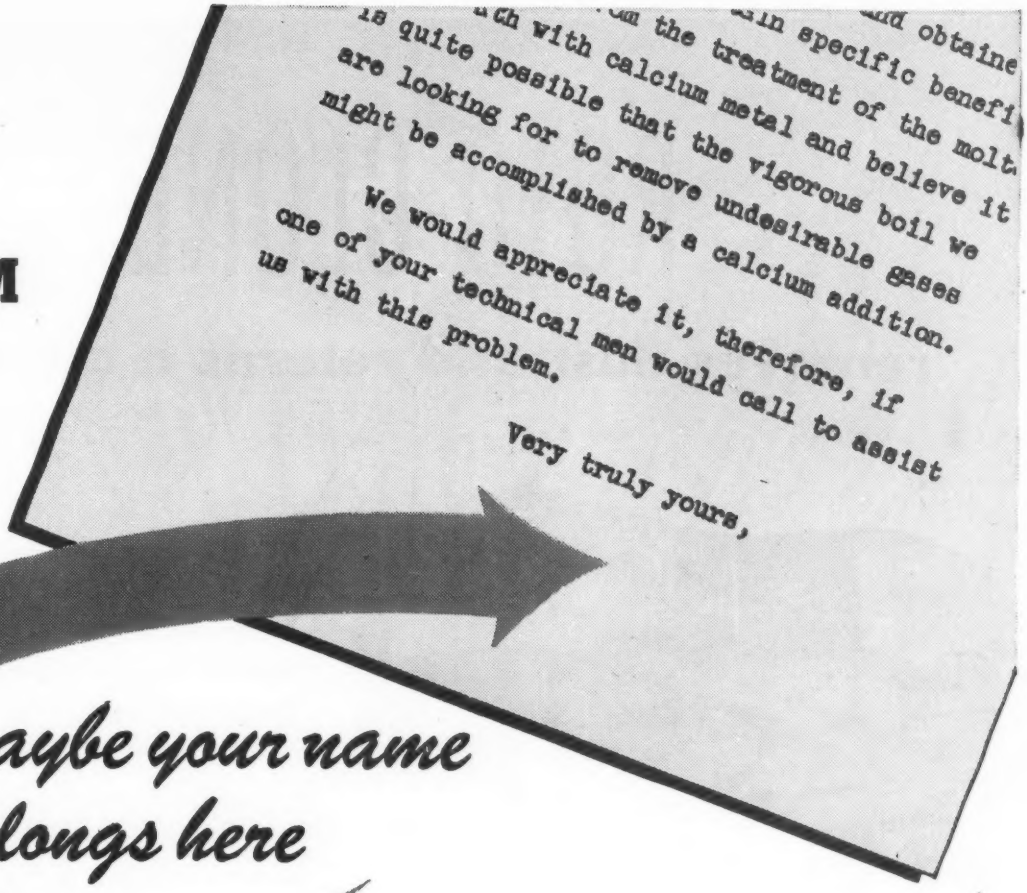
Consulting *Engineers*

600 W. JACKSON BLVD.
CHICAGO 6, ILLINOIS

30 CHURCH STREET
NEW YORK 7, NEW YORK

CONSULTING SERVICE
for Management • Sales • Production

ENGINEERING SERVICE
for Surveys • Modernization • Mechanization


Because
CALCIUM
has so
many
uses
maybe your name
belongs here
and obtaine
in specific benefi
the treatment of the molt
ch with calcium metal and believe it
is quite possible that the vigorous boil we
are looking for to remove undesirable gases
might be accomplished by a calcium addition.
We would appreciate it, therefore, if
one of your technical men would call to assist
us with this problem.
Very truly yours,

This is your invitation to learn how calcium may help you in your chemical and metallurgical operations.

This highly reactive metal is not a tonnage product. Small amounts often work wonders. That is why its many uses, some of which are listed on the right, are not well known.

If these applications suggest ways you might use calcium, we shall be glad to have one of our metallurgical engineers assist you. Please write to our Technical Service Department in New York.

Typical Uses of CALCIUM

Magnesium • Improves surface properties of castings, and heat-treating characteristics of wrought products.

Stainless Steel • Deoxidizer for stainless and other steels that must be exceptionally clean and uniform.

Copper • Deoxidizer and cleanser.

Other Metals • Reducing agent in producing difficult-to-reduce metals . . . alloying agent in bearing metals, such as lead.

Chemical Uses • Absorbent for oxygen, hydrogen, nitrogen, and other gases . . . preparation of metal-organics for syntheses . . . dehydrating agent for alcohols and other organic chemicals . . . desulphurization of petroleum products.

ELECTRO METALLURGICAL COMPANY

Unit of Union Carbide and Carbon Corporation

30 East 42nd Street UCC New York 17, N. Y.

Offices: Birmingham • Chicago • Cleveland • Detroit
New York • Pittsburgh • San Francisco

In Canada: Electro Metallurgical Company of Canada, Limited, Welland, Ontario

Electromet

TRADE MARK

Ferro-Alloys and Metals

ROTO-CLONE

removes dust and returns a dividend

*Roto-Clone is the trade-mark (Reg. U.S. Pat. Off.) of the American Air Filter Company, Inc., for various dust collectors of the dynamic precipitator and hydro-static precipitator types.

THE heavy dust loads created by modern abrasive cleaning offer two problems. One, continued efficiency of the cleaning operation depends upon effective removal of the dust. Two, failure to properly control this by-product results in undesirable working conditions.

Illustrated is an airless blasting operation where both these problems have been solved with the installation of a Type N Roto-Clone* Hydro-Static Precipitator. Dust separation obtained by a combination of centrifugal force and thorough scrubbing of the air by water sprays makes for extremely high collection efficiency. The Type N requires a minimum of attention, exhausts a constant air volume for effective dust removal and eliminates all secondary dust problems by ejecting the collected material as a sludge for easy disposal.

Higher cleaning efficiency, better working conditions — both these dividends are yours with the application of Roto-Clone Dust Control to abrasive cleaning. For complete information, write for Bulletin 270-A or contact your local AAF representative.

AMERICAN AIR FILTER COMPANY, INC.
104 Central Avenue • Louisville 8, Ky.
In Canada: Darling Brothers, Ltd., Montreal, P. Q.

AAF
ROTO-CLONE*
DUST CONTROL EQUIPMENT

Making Way for Progress!

GENERAL OFFICES AND WAREHOUSE, 18TH STREET AT VERNOR HIGHWAY WEST

AFTER more than *45 years continuous occupancy* of our old location on Third Street, we have moved to the new and larger buildings shown above—making room for civic improvements.

Our new property, on *Eighteenth Street at Vernor Highway West,* provides more than *double the floor space* of our former plant . . . larger, more modern offices and laboratories . . . *increased manufacturing and warehouse area* . . . all under one roof. Our Facing Mill at 22nd Street and MCRR is within a short distance.

With these greatly increased facilities, we are in a position to serve your needs more efficiently than ever.

To all our customers and friends, we extend a cordial invitation to visit our modern plant when in Detroit. Make it your *headquarters* for "EVERYTHING FOR A FOUNDRY."

FREDERIC B. STEVENS INCORPORATED

DETROIT 16, MICHIGAN

- NEW ENGLAND . . 166-182 Brewery St., New Haven, Conn.
- NEW YORK and PENNSYLVANIA . . 93 Stone St., Buffalo, N. Y.
- INDIANA . . Hoosier Supply Co., 36 Shelby St., Indianapolis, Ind.
- CANADA . . FREDERIC B. STEVENS OF CANADA, LIMITED
- 1262 McDougall St. . . . . Windsor, Ontario
- 41 Dover Court . . . . . Toronto, Ontario

Costs Nothing! Saves You Plenty!
FREE Wall Chart
Tells How To Handle Aluminum in Foundries

says: Don't knock yourself out!
Here's how to save time and trouble in handling ALUMINUM!
DON'T
DO
Federated METALS DIVISION
AMERICAN SMELTING AND REFINING COMPANY
120 BROADWAY, NEW YORK 5, NEW YORK

Here's another Federated service . . . an easy-to-read series of DO's and DON'Ts for the foundry that casts aluminum.

Every bit of information on this wall chart is backed by the vast research and technical experience of Federated, "first in the non-ferrous field."

This colorful poster is big enough to be read at a distance . . . is printed on heavy varnished paper with weighted borders . . . will hang flat, wipe off easily with a damp cloth, and last for years.

Every DO and every DON'T on this chart can save you TIME, TROUBLE, and MONEY.

Clip the coupon NOW and let Federated start working for you. Other available literature listed in coupon.

See Federated First For Non-Ferrous Metals

Aluminum Alloys	**Copper Base Alloys**
Magnesium Alloys	**Copper-Nickel Alloys**
Zinc Base Alloys	**Deoxidizers & Hardeners**

All made to rigid specifications

Federated
METALS DIVISION

AMERICAN SMELTING AND REFINING COMPANY
120 BROADWAY, NEW YORK 5, N.Y.

Federated first in the non-ferrous field FMD

JMLcoF-AA1

FEDERATED METALS DIVISION Dept. AF
American Smelting and Refining Company
120 Broadway, New York 5, New York

Please send me one ( ), two ( ), wall charts as pictured above. Also send copies of:

- ☐ Non-Ferrous Metals and Alloys Booklet
- ☐ Test Bars Booklet
- ☐ Aluminum Casting Alloys Booklet
- ☐ Reprints of technical articles

My Name.....
Company Name.....
Address.....
City.....Zone.....State.....

SHORTAGE OF MELTING STOCK IN MALLEABLE CASTINGS INDUSTRY

THE TRANSITION OF the malleable industry from production for the war to production for the pursuits of peace, in most cases, did not involve great change. The fundamental uses, in which malleables are employed, are so basic that they are as essential for military movement as for civilian. Furthermore, the demands made upon the industry in time of war are so comparable to those in time of peace that, during the war, no overexpansion was necessary or desirable. True, improvements in plants and equipment have been made, thereby increasing facilities somewhat, but not to a degree where they are seriously out of balance with normal demand.

The wisdom of the industry in not expanding for expansion's sake is now as apparent as it was during the war. In the war period, a realistic analysis revealed that more men, not more or larger plants were required to increase malleable production. Today the case is comparable, as more melting stock, not more capacity, is required to increase and maintain malleable production. Production is just about keeping pace with demand, although an increase in available amounts of pig iron and scrap would be helpful in meeting all requirements at earlier dates.

During the war the paramount malleable foundry problem was manpower; today the greatest problem is melting stock, especially pig iron. This is not to infer that the manpower problem has entirely vanished. In some areas it is still a sufficiently important factor to affect local production at times. The pig iron problem, however, is one which has become quite universal, and which is supplemented by a scarcity of good coke.

Our division is conscious of the desire of malleable users to supplement their large use of standard malleable iron by taking advantage of the possibilities of pearlitic malleable in its various forms. During the past year marked interest has been displayed by the automotive industry in special applications of pearlitic malleables. In certain of these applications, it has been desired to utilize the localized hardening possibilities of malleables to best advantage. To aid in establishing and extending such use, our division's Research Committee recommended an A.F.A. investigation to determine the most suitable pearlitic malleable structure for localized hardening purposes. This project has been approved and the study is being conducted at the University of Michigan, Ann Arbor. We believe that worthwhile information will be developed and that increased specialized use of malleable products may well result.

In our opinion, 1948 will continue to be a year of excellent activity in the Malleable Division of the foundry industry.

LEON J. WISE, *Chairman*
Malleable Division
AMERICAN FOUNDRYMEN'S ASSOCIATION

LEON J. WISE is one of the men responsible for the Chicago chapter's popular annual lecture course series. He launched this idea while serving as President, A.F.A. Chicago chapter. Mr. Wise is serving as assistant to the president, Chicago Malleable Castings Co., and general manager, Allied Steel Casting Co., Harvey, Ill. He assumed his position as division chairman, July, 1947.

1948 PROGRAM AND EXHIBIT GEARED TO INDUSTRY PROGRESS

INTEREST of manufacturers in the foundry market is clearly indicated in the first report on contracts for exhibit space at the 1948 Foundry Show, as presented to the A.F.A. Board of Directors at its Mid-Year Meeting in Chicago, January 22.

On that date, more than three months before the 52nd Annual Meeting, 80 per cent of available space in Philadelphia Convention Hall had been contracted for by producers of equipment, supplies and services for the castings field.

Representation before the international castings industry audience that will be in Philadelphia for the Foundry Congress and Show, May 3-7, has been made an important part of the sales program of organizations.

Many New 1948 Exhibitors

As previously reported, many companies that did not participate in the record-breaking "Golden Jubilee" meeting of 1946 in Cleveland will be represented in Philadelphia this May; these total approximately 20 per cent of 1948 exhibitors already reported.

Of those who took part in the Cleveland show, approximately 65 per cent have already contracted for space at Philadelphia. The more than 220 exhibitors who have reserved space for this year's show comprise an estimated 85 per cent of the total that can be accommodated in Convention Hall.

Foundrymen will study with keen interest the new and improved products that were not yet out of the design stage in 1946, as production tools for use in maintaining high-level castings output in the face of the present shortages and substitutions.

Augmenting the mammoth display of materials for the foundry, the technical program of the Convention will present up-to-the-minute data on production and control techniques in the most modern castings plants.

Three lecture courses will offer timely operational data this year: the special series sponsored by the A.F.A. Annual Lecture Committee and covering recommended practices in quality control test procedures for all types of foundries, and the popular, informal Gray Iron and Sand Shop courses.

K. H. Priestly, Vassar (Mich.) Electroloy Products Co., Chairman of the Gray Iron Shop Operation Course Committee, has announced the following speakers:

J. A. Bowers, American Cast Iron Pipe Co., Birmingham, *Cupola Coke in Relation to Carbon Control.*

B. P. Mulcahy, engineering consultant, Indianapolis, *Effect of Blast Variation on Cupola Control.*

T. W. Curry, Lynchburg (Va.) Foundry Co., *Front Slagging of the Cupola.*

Rudolph Flora, Clover Foundry, Muskegon, Mich., *Factors Affecting Fluidity of Cupola Iron.*

Sessions will be held at 8:00 pm daily, Monday through Thursday.

Delegates from all branches of the casting field will be particularly interested in the program of the A.F.A. Educational Division, in view of the fact that the industry has recently taken steps to establish improved facilities for the education of foundry engineers and technologists.

The Division's technical session Monday morning, May 3, will present a six-man panel of speakers in a question-and-answer session on problems related to the recruiting and training of foundry personnel.

Division Chairman F. G. Sefing, International Nickel Co., New York, has announced that M. J. Gregory of Peoria, Ill., retired foundry superintendent of Caterpillar Tractor Co. and a past A.F.A. Director, will be the speaker at the round table meeting Monday. He will discuss "Management's Responsibility in the Development of Personnel."

Professor R. M. Brick, director of the department of metallurgy at the University of Pennsylvania, Philadelphia, will address the Engineering School Graduates Luncheon of the Division, Wednesday.

A. L. Pfeiffer, Allis-Chalmers Mfg. Co., Milwaukee, Chairman of the Pattern Division, has announced that Division Vice Chairman L. F. Tucker, City Pattern & Foundry Co., Inc., South Bend, Ind., will preside at the Division Round Table Luncheon, Wednesday.

List Malleable Division Papers

Among the technical papers scheduled by A.F.A. Divisions are *Application of Correlation in the Malleable Foundry,* by R. G. Seidel, National Malleable & Steel Castings Co., Cleveland; *Production Hardness Testing in a Malleable Shop,* C. Schneider and L. Ulsenheimer, of the same firm; *The Effect of Mn-S Ratio on the Rate of Anneal of Black Heart Malleable Iron,* J. E. Rehder, Bureau of Mines, Ottawa, Canada, and *Construction and Operation of an Oil-Fired Malleable Holding Furnace,* Fitz Coghlin, Jr., Albion (Mich.) Malleable Iron Co., all Malleable Division.

A Fluidity Test for Aluminum Casting Alloys, by W. E. Sicha, Aluminum Co. of America, Cleveland, and *Al-Zn-Mg-Cu Casting Alloys,* L. W. Eastwood and L. W. Kempf, Battelle Memorial Institute, Columbus, Ohio, are included on the Aluminum and Magnesium program; *Improvement in Machineability in High*

Phosphorus Gray Iron, W. W. Austin, Jr., Southern Research Institute, Birmingham, on the Gray Iron.

Steel papers include *Tensile Properties versus Composition of Normalized Cast Steel,* W. K. Bock and H. A. Schwartz, National Malleable & Steel Castings Co.; *Statistical Quality Control—A New Tool for the Foundryman,* G. A. Fisher and H. H. Johnson, of the same firm; *The Delayed Quench for Steel Castings,* S. L. Gertsman, Bureau of Mines, Ottawa, and *A Theoretical Approach to the Problem of Dimensioning of Risers,* J. B. Caine, Sawbrook Steel Castings Co., Lockland, Ohio.

Mr. Caine will also present *Changes in Chemistry of Liquid Steel in Contact with Sand,* the report of the Sand Division Mold Surface Committee, of which he is Chairman. The A.F.A. Heat Transfer Committee will present a report of four technical papers, with an introduction by Chairman H. A. Schwartz.

Partial List of Exhibitors for 1948 Foundry Show

*Accurate Match Plate Co. ..... Chicago, Ill.
The Adams Co. ..... Dubuque, Iowa
Air Reduction Sales Co. ..... New York 17, N.Y.
Ajax Electrothermic Corp. ..... Philadelphia, Pa.
Ajax Engineering Co. ..... Philadelphia, Pa.
Ajax Flexible Coupling Co. Inc. ..... Westfield, N.Y.
Ajax Metal Co. ..... Philadelphia, Pa.
Allis-Chalmers Mfg. Co. ..... Milwaukee, Wis.
**The Alpha-Lux Company, Inc. ..... New York, N.Y.
American Air Filter Co., Inc. ..... Louisville, Ky.
American Crucible Co. ..... Shelton, Conn.
**American Gas Association ..... New York, N.Y.
**American Optical Co. ..... Southbridge, Mass.
**American Lacquer Solvents Co. ..... Phoenixville, Pa.
American Metal Market Co. ..... New York 7, N.Y.
American Wheelabrator & Equip. Corp. ..... Mishawaka, Ind.
Arcade Mfg. Div. (Rockwell Mfg. Co.) ..... Milwaukee, Wis.
*Arcos Corporation ..... Philadelphia, Pa.
The Asbury Graphite Mills, Inc. .. Asbury, Warren County, N.J.
Ayers Mineral Co. ..... Zanesville, Ohio

*Baroid Sales Div., National Lead Co. ..... Los Angeles, Calif.
The C. O. Bartlett & Snow Co. ..... Cleveland 5, Ohio
The Beardsley & Piper Co. ..... Chicago, Ill.
*Bell Aircraft Corp. ..... Buffalo 5, N.Y.
Blaw-Knox Div. of Blaw-Knox Co. ..... Pittsburgh, Pa.
Bloomsbury Graphite Co. ..... Bloomsbury, N.J.
Bohn Aluminum & Brass Corp. ..... Detroit, Mich.
Bradley Washfountain Co. ..... Milwaukee, Wis.
Buckeye Tools Corp. ..... Dayton 1, Ohio
*Butler Bin Co. ..... Waukesha, Wis.

The Campbell-Hausfeld Co. ..... Harrison, Ohio
*Capewell Manufacturing Co. ..... Hartford, Conn.
Certified Core Oil Div., Socony Vacuum Oil Co. Inc. ..... Cicero 50, Ill.
Chain Belt Co. ..... Milwaukee 4, Wis.
Champion Foundry & Machine Co. ..... Chicago 8, Ill.
Chicago Pneumatic Tool Co. ..... New York 17, N.Y.
*Christiansen Corp. ..... Chicago, Ill.
Clearfield Machine Co. ..... Clearfield, Pa.
The Cleveland Flux Co. ..... Cleveland 13, Ohio
The Cleveland Vibrator Co. ..... Cleveland, Ohio
Climax Molybdenum Co. ..... New York 18, N.Y.
Columbus McKinnon Chain Corp. ..... Tonawanda, N.Y.
Corn Products Sales Co. ..... New York, N.Y.
Crescent Machine Div. (Rockwell Mfg. Co.) .. Milwaukee, Wis.

Davenport Machine & Foundry Co. ..... Davenport, Iowa
**Davey Compressor Co. ..... Kent, Ohio
Dayton Oil Co. ..... Dayton, Ohio
Dayton Pneumatic Tool Co. ..... Dayton, Ohio
**Debevoise-Anderson Co., Inc. ..... New York, N.Y.
Delta Mfg. Div. (Rockwell Mfg. Co.) ..... Freeport, Ill.
Delta Oil Products Co. ..... Milwaukee, Wis.
Wm. Demmler & Bros. ..... Kewanee, Ill.

*Have never Exhibited
**Did not Exhibit in 1946

Despatch Oven Co. ..... Minneapolis 14, Minn.
Kuhlman Electric Co. (Detroit Elec. Furnace Div.) ..... Bay City, Mich
Harry W. Dietert Co. ..... Detroit 4, Mich.
**Dings Magnetic Separator Co. ..... Milwaukee, Wis.
Joseph Dixon Crucible Co. ..... Jersey City 3, N.J.
The DoAll Co. ..... Minneapolis 4, Minn.
Dougherty Lumber Co. ..... Cleveland 5, Ohio
Duquesne Smelting Corp. (American Metal Co. Ltd.) ..... Pittsburgh, Pa.

Eastern Clay Products, Inc. ..... Jackson, Ohio
Eastman Kodak Co. ..... Rochester 4, N.Y.
Electro Metallurgical Co. (Union Carbide & Carbon Corp.) ..... New York, N.Y.
**Electro Refractories & Alloys Corp. ..... Buffalo, N.Y.
*Engineering Manufacturing Co. ..... Sheboygan, Wis.
Eutectic Welding Alloys Corp. ..... New York, N.Y.
*Exomet, Inc. ..... Conneaut, Ohio

Fabreeka Products Co. ..... Boston 10, Mass.
Federal Foundry Supply Co. ..... Cleveland 5, Ohio
Federated Metals Div. (American Smelting & Refining Co.) ..... New York 5, N.Y.
The Fellows Corp. ..... Milwaukee 3, Wis.
*Foundry Educational Foundation ..... Cleveland, Ohio
The Foundry Equipment Co. ..... Cleveland 13, Ohio
Foundry Equipment Manufacturers Assn. .. Cleveland 14, Ohio
The Foxboro Co. ..... Foxboro, Mass.
Fox Grinders, Inc. ..... Pittsburgh, Pa.
The Freeman Supply Co. ..... Toledo 5 ,Ohio
The Fremont Flask Co. ..... Fremont, Ohio

General Electric X-Ray Corp. ..... Chicago 12, Ill.
General Grinding Wheel Corp. ..... Philadelphia 34, Pa.
Gray Iron Founders Society ..... Cleveland, Ohio
Great Lakes Foundry Sand Co. ..... Detroit, Mich.
Great Western Mfg. Co. ..... Leavenworth, Kan.
Samuel Greenfield Co., Inc. ..... Buffalo, N.Y.

*Harbison-Walker Refractories Co. ..... Pittsburgh, Pa.
Harnischfeger Corp. ..... Milwaukee, Wis.
**Harrison Abrasive Corp. ..... Elizabeth, N.J.
Hercules Powder Co. ..... Wilmington, Del.
Herman Pneumatic Co. ..... Pittsburgh 22, Pa.
Hickman, Williams & Co. ..... Cleveland 14, Ohio
The Hill & Griffith Co. ..... Cincinnati, Ohio
The Hines Flask Co. ..... Cleveland, Ohio
The Frank G. Hough Co. ..... Libertyville, Ill.
Houghland & Hardy—Hardy Sand Co. ..... Evansville, Ind.
E. F. Houghton & Co. ..... Philadelphia, Pa.
Hydro-Blast Corp. ..... Chicago, Ill.
**Hyster Co. ..... Portland, Oregon

Illinois Testing Laboratories, Inc. ..... Chicago, Ill.
Independent Pneumatic Tool Co. ..... Chicago, Ill.
Induction Heating Corp. ..... Brooklyn 11, N.Y.

Ingersoll-Rand Co. ..... New York, N.Y.
**Interlake Chemical Corp. ..... Cleveland, Ohio
International Graphite & Electrode Corp. ..... St. Mary's, Pa.
International Molding Machine Co. ..... Chicago, Ill.
International Nickel Co., Inc. ..... New York 5, N.Y.
Interstate Smelting & Refining Co. ..... Chicago 4, Ill.
*Invincible Vacuum Cleaner Mfg. Co. ..... Philadelphia, Pa.
The Iron Age ..... New York 17, N.Y.
**The Ironton Fire Brick Co. ..... Ironton, Ohio

The Jeffrey Mfg. Co. ..... Columbus 16, Ohio
The Johnston & Jennings Co. ..... Cleveland, Ohio

The Kindt-Collins Co. ..... Cleveland, Ohio
**Andrew King, Cons. Engr. ..... Narberth, Pa.
Lester B. Knight & Associates, Inc. ..... Chicago, Ill.
H. Kramer & Co. ..... Chicago, Ill.
**Chas. A. Krause Milling Co. ..... Milwaukee 1, Wis.

Lauhoff Grain Co. ..... Danville, Ill.
Lava Crucible Co. of Pittsburgh ..... Pittsburgh 22, Pa.
R. Lavin & Sons, Inc. ..... Chicago, Ill.
*Lindberg Engineering Co. ..... Chicago, Ill.
**Linde Air Products Co. (Union Carbide & Carbon Corp.) ..... New York, N.Y.
Link-Belt Co. ..... Chicago, Ill.

The Macleod Co. ..... Cincinnati, Ohio
Manly Sand Co. ..... Rockton, Ill.
Martin Engineering Co. ..... Kewanee, Ill.
Martindale Electric Co. ..... Cleveland 7, Ohio
**Master Pneumatic Tool Co. Inc. ..... Orwell, Ohio
Material Movement Industries, Inc. ..... Chicago 4, Ill.
Mathews Conveyors Co. ..... Ellwood City, Pa.
J. S. McCormick Co. ..... Pittsburgh 22, Pa.
Metallizing Co. of America ..... Chicago 4, Ill.
Milwaukee Foundry Equipment Co. ..... Milwaukee, Wis.
Mine Safety Appliances Co. ..... Pittsburgh 8, Pa.
Modern Equipment Co. ..... Port Washington, Wis.
The Moulders' Friend (Purity Molding Sand Co.) ..... Dallas City, Ill.

*Morrell Dobbins Vocational-Technical School .... Philadelphia
Nassau Smelting & Refining Co., Inc. ..... New York 7, N.Y.
National Carbon Co. (Union Carbide & Carbon Corp.) ..... New York, N.Y.
*National Crucible Co. ..... Philadelphia, Pa.
National Engineering Co. ..... Chicago 6, Ill.
*National Pigment Co. ..... Philadelphia, Pa.
**National Pulverizing Co. ..... Millville, N.J.
Newaygo Engineering Co. ..... Newaygo, Mich.
New Jersey Silica Sand Co. ..... Millville, N.J.
Niagara Falls Smelting & Refining Div. (Continental-United Industries Co., Inc.) .. Buffalo 17, N.Y.
Wm. H. Nicholls Co., Inc. ..... Richmond Hill 18, N.J.
Nichols Engineering & Research Corp. ..... New York 5, N.Y.
Non-Ferrous Founders' Society ..... Chicago, Ill.
North American Smelting Co. ..... Philadelphia 34, Pa.

The S. Obermayer Co. (Ramtite Co.) ..... Chicago 8, Ill.
Oliver Machinery Co. ..... Grand Rapids, Mich.
The Osborn Mfg. Co. ..... Cleveland 14, Ohio

P M S Company ..... Cleveland 14, Ohio
**Palmer Bee Co. ..... Detroit 12, Mich.
Pangborn Corp. ..... Hagerstown, Md.
The Peninsular Grinding Wheel Co. ..... Detroit, Mich.
**Penn-Rillton Co. ..... New York
**Pennsylvania Foundry Supply & Sand Co. ... Philadelphia, Pa.
Penola Inc. ..... Pittsburg 1, Pa.
The Penton Publishing Co. ..... Cleveland 13, Ohio
George F. Pettinos, Inc. ..... Philadelphia 7, Pa.
*George Pfaff Inc. ..... Long Island 1 ,N.Y.
Pittsburgh Crushed Steel Co. ..... Pittsburgh 1, Pa.
Pittsburgh Lectromelt Furnace Corp. ..... Pittsburgh, Pa.
Pittsburgh Metals Purifying Corp. ..... Pittsburgh 12, Pa.
*Plastic Corp. of Chicago ..... Cicero, Ill.
Powermatic Ventilator Co. ..... Cleveland 3, Ohio
Pratt & Whitney, Div. Niles-Bement-Pond Co. ..... West Hartford 1, Conn.
**Pulmosan Safety Equipment Corp. ..... Brooklyn, N.Y.
The Pyro-Clay Products Co. ..... Oak Hill, Ohio
The Pyrometer Instrument Co. ..... New York 13, N.Y.

Radium Chemical Co., Inc. ..... New York 22, N.Y.
The Ramtite Co. (S. Obermayer Co.) ..... Chicago 8, Ill.
N. Ransohoff, Inc. ..... Cincinnati, Ohio
Ready-Power Co. ..... Detroit 8, Mich.
Redford Iron & Equipment Co. ..... Detroit 19, Mich.
*The Reed Roller Bit Co. (Cleco Div.) ..... Houston, Texas
*W. G. Reichert Engineering Co. ..... Newark, N.J.
Republic Coal & Coke Co. ..... Chicago, Ill.
H. H. Robertson Co. ..... Pittsburgh 22, Pa.
Robins Conveyors Div., Hewitt-Robins Inc. ..... Passaic, N.J.
**Roots-Connersville Blower Corp. ..... Connersville, Ind.
**Ross-Tacony Crucible Co. ..... Tacony, Pa.
The Rotor Tool Co. ..... Cleveland 12, Ohio
Royer Foundry & Machine Co. ..... Kingston, Pa.

Safety Clothing & Equipment Co. ..... Cleveland 3, Ohio
Claude B. Schneible Co. ..... Detroit 16, Mich.
**A. Schrader's Son Div., Scovill Mfg. Co. ..... Brooklyn, N.Y.
Schramm, Inc. ..... West Chester, Pa.
**The Scientific Cast Products Corp. ..... Cleveland 3, Ohio
Semet-Solvay Div. (Allied Chemical & Dye Corp.) ..... New York 6, N.Y.
Severance Tool Industries, Inc. ..... Saginaw, Mich.
The Shanafelt Mfg. Co. ..... Canton, Ohio
Simonds Abrasive Co. ..... Philadelphia 37, Pa.
Simplicity Engineering Co. ..... Durand, Mich.
W. W. Sly Manufacturing Co. ..... Cleveland, Ohio
The Werner G. Smith Co. ..... Cleveland 2, Ohio
The Smith Facing & Supply Co. ..... Cleveland 13, Ohio
Smith Oil & Refining Co. ..... Rockford, Ill.
The Spencer Turbine Co. ..... Hartford 6, Conn.
SPO Inc. ..... Cleveland 5, Ohio
Springfield Facing Co. ..... Harrison, N.J.
Standard Conveyor Co. ..... St. Paul 9, Minn.
*Standard Electrical Tool Co. ..... Cincinnati, Ohio
Standard Horse Nail Corp. ..... New Brighton, Pa.
Sterling Wheelbarrow Co. ..... Milwaukee 14, Wis.
Frederic B. Stevens, Inc. ..... Detroit 26, Mich.
Stroman Furnace & Engineering Co. ..... Chicago 6, Ill.
*Superior Manufacturing Co. ..... Cleveland, Ohio
Swan-Finch Oil Corp. ..... New York 20, N.Y.
Syntron Co. ..... Homer City, Pa.

The Tabor Mfg. Co. ..... Philadelphia 35, Pa.
Taggart & Co. ..... Philadelphia 35, Pa.
Tamms Silica Company ..... Chicago 1, Ill.
Thiem Products, Inc. ..... Milwaukee 4, Wis.

Union Carbide & Carbon Corp. ..... New York 17, New York
United Oil Mfg. Co. ..... Erie, Pa.
United States Graphite Co. ..... Saginaw, Mich.
United States Hoffman Machinery Corp. ..... New York 3, N.Y.
U. S. Reduction Co. ..... East Chicago, Ind.

Vanadium Corporation of America ..... New York 17, N.Y.
Vesuvius Crucible Co. ..... Pittsburgh 18, Pa.

**Jervis B. Webb Co. ..... Detroit 4, Mich.
*The Wellman Products Co. ..... Cleveland, Ohio
**White Bros. Smelting Corp. ..... Philadelphia 37, Pa.
Whitehead Brothers Co. ..... New York 1, N.Y.
Whiting Corp. ..... Harvey, Ill.
Wilson Industries, Inc. ..... Boston

The Yale & Towne Mfg. Co. ..... Philadelphia 24, Pa.
Young Bros. Co. ..... Detroit

*Have never Exhibited
**Did not Exhibit in 1946

Directors Hear Association Plans In Chicago As A.F.A. Board Meets

OFFICERS AND DIRECTORS of the Association held their regular mid-year meeting at the LaSalle Hotel, Chicago, on January 21 and 22, to consider advancement of A.F.A. activities and reports on progress of the 52nd Annual Meeting in Philadelphia.

President Max Kuniansky, Lynchburg Foundry Co., Lynchburg, Va., presided, and the following directors were in attendance:

H. A. Deane, Brake Shoe & Castings Div., American Brake Shoe Co., New York; E. H. Delahunt, Warden King, Ltd., Montreal, Que., Canada; R. R. Gregg, Reliance Regulator Corp., Alhambra, Calif.; E. W. Horlebein, Gibson & Kirk Co., Baltimore, Md.; H.H. Judson, Worcester, Mass.; J. E. Kolb, Caterpillar Tractor Co., Peoria, Ill.; H. G. Lamker, Wright Aeronautical Corp., Wood Ridge, N.J.; W. J. MacNeill, G. H. R. Div., Dayton Malleable Iron Co., Dayton, Ohio; R. H. McCarroll, Ford Motor Co., Dearborn, Mich.; John M. Robb, Jr., Hickman, Williams & Co., Inc., Philadelphia; B. L. Simpson, National Engineering Co., Chicago; J. H. Smith, Central Foundry Div., General Motors Corp., Saginaw, Mich.; S. C. Wasson, National Malleable & Steel Castings Co., Cicero, Ill.; and F. M. Wittlinger, Texas Electric Steel Castings Co., Houston, Texas.

One important matter on which Board approval was registered concerned recommendations of a By-Laws Committee. At the direction of the Board these revisions now will be printed and submitted to the members for their approval in accordance with Art. XIX of the By-Laws.

It is expected that the recommended revisions will establish the Association more strongly as a technical society and will make definite provision for present and contemplated activities undertaken in recent months.

In line with the Association's Educational Program and recommendation of the Educational Division to prepare textbooks at several training levels; decision was reached on the selection of an author for the first text to be published, for use in engineering schools and colleges. The Board also reiterated its intention of continued cooperation with the Foundry Educational Foundation and its program in conjunction with six major engineering schools in the country.

Over 10,000 A.F.A. Members

A report on membership by A.F.A. Secretary, Wm. W. Maloney, showed a membership of 10,280 as of December 31, representing the first time that the A.F.A. roster of membership has exceeded 10,000. The Secretary called attention to the constant and devoted work of the Chapter Membership Committees in making this phenomenal record possible, and announced that the impetus of the Philadelphia convention undoubtedly would add still further to the membership rolls.

The Secretary also reported imminent formation of a new chapter at Chattanooga, Tennessee, and the approval of four chapters thus far this year. These are: The Eastern New York Chapter at Albany; and the Student chapters of the University of Minnesota, Minneapolis; University of Missouri School of Mines and Metallurgy, Rolla; Ohio State University, Columbus.

Petition for a student chapter at MIT having been received just prior to the Board Meeting, the Directors unanimously voted approval. A more complete story on the MIT chapter is contained on page 26. Other student chapters are now being formulated.

A progress report on the Philadelphia Foundry Congress indicated that an excellent group of papers would be preprinted well in advance of the meeting and thoroughly discussed during the Convention. Evidence was presented indicating that more new and newly developed equipment would be displayed at the Exhibit Halls than in many years. A partial list of Exhibitors, shown on page 23, features some 46 companies who were not present at the 1946 Foundry Show, and over 20 of whom have never been represented before.

Form National Castings Council

President Kuniansky reported on formation of a formalized National Castings Council organization at a meeting held in Cleveland January 15. He stated that one of the first subjects to be considerd by the Council would concern the need for a strong Safety and Hygiene Program on behalf of the Foundry Industry with A.F.A. one of the main sponsoring bodies.

Dr. Compton, President, MIT To Be A.F.A. Annual Banquet Speaker

DR. KARL TAYLOR COMPTON, president of Massachusetts Institute of Technology, Cambridge, will be the guest speaker at the 1948 Annual Banquet of A.F.A. in Philadelphia, May 7. His topic is "Team Play of Hand and Brain."

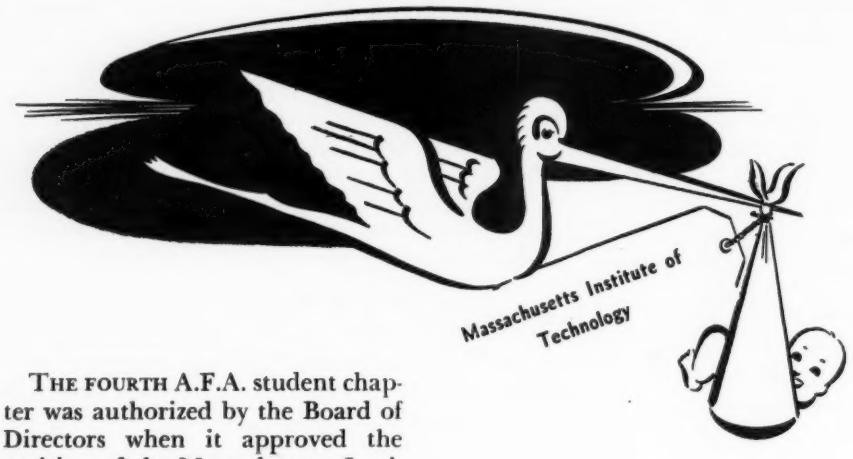
Dr. K. T. Compton

His own conception of the basic factor in the advance of civilization is summarized in that title. Dr. Compton has often stated his conviction that education in science and engineering, combined with an understanding of the social implications of developments in those professions, is the best basis for industrial and social progress.

He has given generously of his own time in public services; played a leading role in directing the application of science to the war effort during the recent conflict, and has since had a similar part in its direction to industrial recovery. Dr. Compton served on the War Resources Board, the National Defense Research Committee, as chairman of the Radar Committee of the new weapons group of the Joint Chiefs of Staff, and as chief of Field Service of the Office of Scientific Research and Development, among a large number of similar important assignments.

Head of MIT since 1930 and a participant in such developments of national and international significance for many years, Dr. Compton is recognized as an outstanding scientist, educator, and administrator. He was awarded the Marcellus Hartley medal, National Academy of Sciences (1947); Rumford medal (1931).

NON-CHAPTER A.F.A. MEMBERS HELP FORM STUDENT CHAPTER



THE FOURTH A.F.A. student chapter was authorized by the Board of Directors when it approved the petition of the Massachusetts Institute of Technology, Cambridge, student foundry group January 22. Meeting to organize on January 13, the same day on which the third student chapter at the Ohio State University, Columbus, was installed, the 45 petitioners elected officers and set up the advisors required under student chapter policy.

Faculty advisor is H. F. Taylor, associate professor of mechanical engineering, MIT, member of several A.F.A. educational and technical committees. R. F. Harrington, assistant works manager, Hunt-Spiller Mfg. Corp., Boston, and John A. Penton gold medallist in 1943, is industrial advisor. Officers of the MIT Student Chapter are Gerald J. Grott, *Chairman;* Leonard N. McKibben, *Vice-Chairman;* Martin J. O'Brien III, *Secretary-Treasurer;* and Loris M. Diran, *Technical Secretary*.

Far from an existing A.F.A. chapter, the MIT Student Chapter will not have the benefit of close affiliation with an A.F.A. industrial group. Close cooperation is expected, however, between the students and A.F.A. members in the Boston area.

Students who petitioned for recognition as the MIT Student Chapter of the American Foundrymen's Association are: Gerald J. Grott, Frederick I. Brown, Jr., Martin J. O'Brien, William F. Halbleib, John D. Eichenberg, Clyde M. Adams, George Kotzenbecker, David L. Yeomans, Diderik Cappelen, Thomas George Zsembik, David Klaiman, Manuel B. Gassman, Angelo R. Arena, Norman S. Andrews, Stanley Collis, Kenneth W. McGrath, S. Andrew Kolin, Vijay G. Porenske, John E. Fries, Jr., Leonard N. McKibben, Randall K. Cleworth, Dean S. Amner, Thomas J. McLeer, Jr., Jan M. Hoegfeldt, Jack D. Winninghoff, Alfred J. Murrer, Lloyd R. Allen, Behram H. Wadia, Carl L. Kolbe, F. D. Losco, Jerry M. Zilka, William A. Schmidt, Walter E. Moore, Jr., Sheldon I. Kaplan, Ployer P. Hill, John C. Avellac, Eustace W. Cummings, Roland L. Ruetz, Robert N. Randall, Michael F. Oglo, Loris M. Diran, Robert E. Savage, Warren L. Larson, Walter F. Wagner, and Leo E. Weaver, Jr.

AFA College Placement List Is Now Available

ENGINEERING COLLEGE placement officers, graduation dates, and senior interview dates are shown for the major engineering colleges in the A.F.A. ENGINEERING COLLEGE PLACEMENT LIST recently issued by the American Foundrymen's Association. The 130 colleges listed are approved by the Engineers' Council for Professional Development.

Useful to management planning to interview engineering college seniors, the list is a helpful adjunct to the recruiting article in the December issue of AMERICAN FOUNDRYMAN. Entitled "Engineering Graduates—College Recruiting for the Foundry Industry," this article by David J. Mack; assistant professor of metallurgy, University of Wisconson, Madison, gives an authoritative picture of some present day personnel problems faced by the foundry.

Foundry management in general does not realize the magnitude of the competition for college graduates, according to Professor Mack. The shortage of technically trained graduates in the metallurgy industries is especially acute. As a result, starting salaries have gone up and graduates are shopping around.

Professor Mack's article gives steps for contacting college placement officers and students and explains the type of information students are interested in. Since no small group of engineering schools can fill the yearly demand of the foundry industry for graduate engineers, the A.F.A. college placement list is helpful in contacting all the country's major engineering schools.

The A. F. A. ENGINEERING COLLEGE PLACEMENT LIST can be obtained at no cost from the A.F.A., 222 W. Adams St., Chicago 6.

Educational Work Is Initiated at Vancouver

WITH THE A.F.A. industrywide educational program as a guide, the eight-month old British Columbia chapter set up an educational program within 30 days. Selecting two of the six educational activities recommended to chapters and described in detail, the chapter educational committee organized an apprentice contest and an educational course.

British Columbia representatives in the 1948 A.F.A. Apprentice Contest will be selected in the local contest to be held late in February.

"Foundry Fundamentals" is the title of the chapter educational course. Consisting of six two-hour meetings held in the visual education room of the Vancouver Technical School, the course includes lectures, round-table discussions, demonstrations and visual aids.

Promoting British Columbia chapter educational activities are: W. M. Armstrong, associate professor of metallurgy, University of British Columbia; Chapter Secretary-Treasurer Lovick P. Young, metallurgist, A-1 Steel & Iron Foundry Ltd.; H. M. Brownrigg, associate research metallurgist, British Columbia Research Council; and J. A. Dickson, owner, Dickson Foundry Co., all of Vancouver.

ENGINEERING FOR ALUMINUM ALLOY CASTINGS

T. R. Gauthier
and
H. J. Rowe
Aluminum Co. of America
Pittsburgh, Pa.

ENGINEERING HAS BEEN DEFINED as the art and science of using the mechanical properties of matter in structures and machines. The field of mechanical and design engineering covers the selection of such matter for the construction and adaptation of machinery. The selection of a structural or engineering material for any application is determined by two basic requisites; the suitability of the material and its method of fabrication, and its cost in the form required.

The engineer may find several engineering materials suitable for an application, in which case the selection of a material is governed primarily by economics. In other instances, one material may be definitely more suitable because of its superior engineering properties or characteristics. In this case, the functional requirements of the structure govern the selection, although the ultimate cost must be carefully balanced against the other necessary engineering properties.

The manner in which the selected engineering material can be fabricated to fit an application is one of the first considerations requiring the decision of the engineer. Aluminum alloys, because they are capable of fabrication by all commercial methods, provide a variety of possibilities from which to make this choice. Among these are castings produced by several processes including sand castings, permanent and semi-permanent mold castings, die castings, and castings produced in other non-metallic refractory type molds. The fabrication of aluminum alloys by the casting processes has been found to fulfill, for many structures, the two basic requisites of an engineering material.

Broadly, the properties and characteristics of aluminum alloy castings are determined by three factors: (1) the alloy composition and its heat treatment, if any; (2) the basic design features; and (3) the casting process by which they are fabricated. Some of the components of these three factors which require consideration by a design engineer are outlined.

Aluminum Alloys—Characteristics

Of first importance to an engineer considering aluminum castings is the physical and mechanical properties of the particular aluminum alloy. When he finds the combination of properties desired, he then must consider some of its other characteristics such as machinability, resistance to corrosion, weldability and, perhaps most important, its casting qualities and adaptability to the specific casting in question and the casting process involved.

Pure aluminum possesses neither mechanical properties nor casting characteristics suitable for general casting use. However, by the addition of other elements in controlled amounts, both of these characteristics can be greatly improved. In addition, heat treatment processes will further increase the mechanical properties of many of these materials as well as provide dimensional stability where this characteristic is required.

Today, a large number of alloys which possess the required characteristics for casting work and provide a wide range of engineering properties are available. Tables 1 and 2 list the nominal composition and some of the mechanical properties of the most commonly

TABLE 1—NOMINAL COMPOSITION OF COMMONLY USED ALUMINUM CASTING ALLOYS [1]

Commercial Designation	ASTM Designation	Nominal Composition, per cent				
		Cu	Si	Mg	Zn	Ni
13	S5	—	12.00	—	—	—
40E[2]	ZG41	Cr 0.50		0.55	5.50	Ti 0.2
43	S1	—	5.00	—	—	—
85	SC2	4.00	5.00	—	—	—
108	CS5	4.00	3.00	—	—	—
A108	SC1	4.50	5.50	—	—	—
113	CS22	7.00	2.00	—	1.70	—
122	CG1	10.00	—	0.20	—	—
A132	SN41	0.80	12.00	1.20	—	2.50
138	CS21	10.00	4.00	0.30	—	—
142	CN21	4.00	—	1.50	—	2.00
152	CS23	7.00	5.50	0.30	—	—
195	C1	4.50	0.80	—	—	—
B195	CS4	4.50	2.50	—	—	—
214	G1	—	—	3.80	—	—
A214	GZ1	—	—	3.80	1.80	—
B214	GS1	—	1.80	3.80	—	—
220	G3	—	—	10.00	—	—
319	SC8	3.50	6.30	—	—	—
355	SC21	1.30	5.00	0.50	—	—
356	SG1	—	7.00	0.30	—	—
360	SG3	—	9.50	0.50	—	—
A360	SG2	—	9.50	0.50	—	—
380	SC7	3.50	9.00	—	—	—
A380	SC6	3.50	9.00	—	—	—

[1] The nominal composition and alloy designations are those of the Aluminum Co. of America.
[2] Frontier Bronze Corp.

This paper was presented at a Metals Engineering Session of the ASME Annual Meeting at Atlantic City, N.J., Dec. 3, 1947.

used aluminum casting alloys as included in the specifications of the American Society for Testing Materials.

Aluminum alloys in which copper is the principal hardening constituent were widely used in the early history of the aluminum casting industry in this country. Such alloys, containing about 8 per cent copper, were used in the as-cast condition, depending upon the alloying addition only for their mechanical properties. Later the 4 per cent copper alloys were developed for sand and permanent mold use. These alloys provided the design engineer with an improved material because they responded to heat treatments, thus developing a superior combination of ductility and strength over the earlier as-cast 8 per cent aluminum-copper alloys.

Athough both the afore-mentioned types of alloys still find use today, they have been substantially replaced by alloys containing silicon as a major alloying element. This trend reflects the better casting characteristics provided by silicon additions and the recognition by designers of the superior mechanical properties of castings as a whole, resulting from the improved casting soundness. Casting production today in the

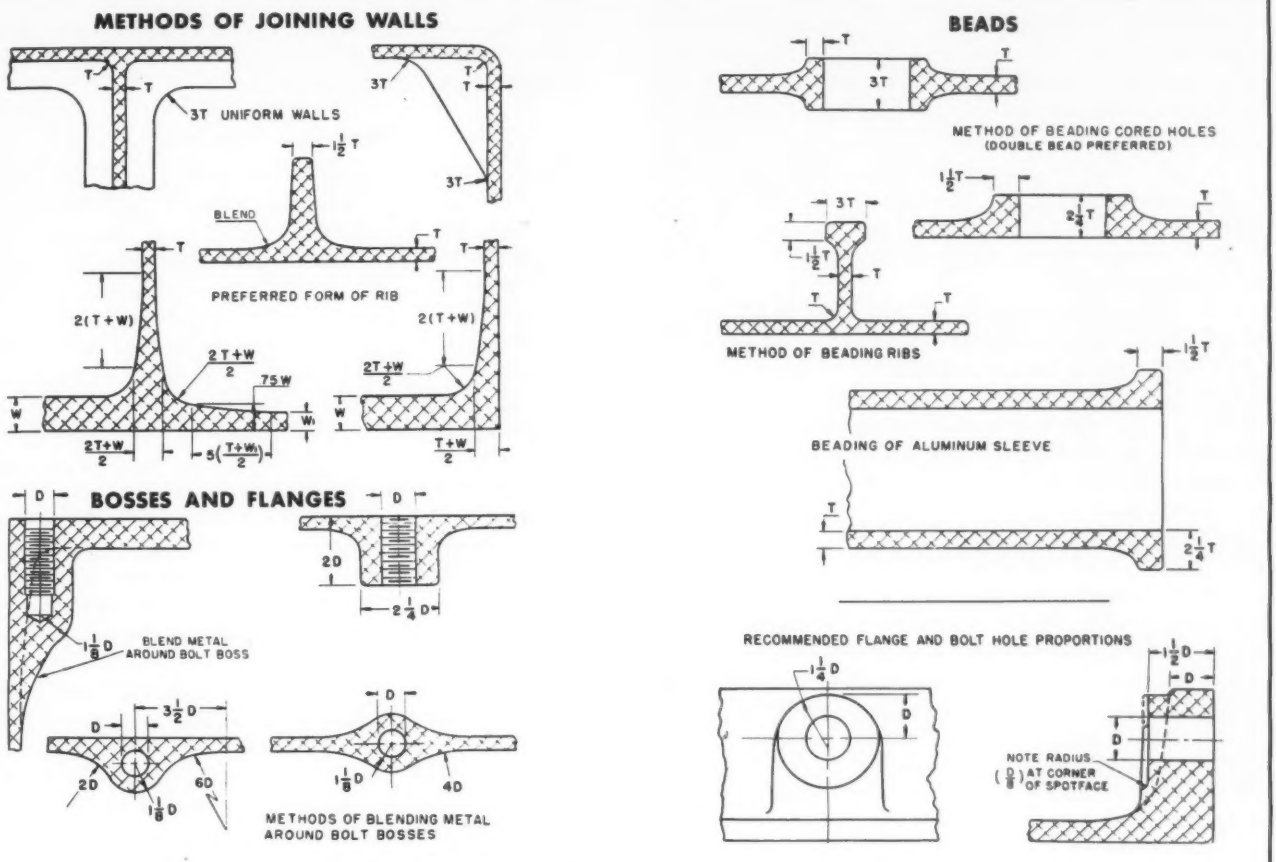
TABLE 2—MECHANICAL PROPERTIES OF COMMONLY USED ALUMINUM CASTING ALLOYS [1]

		Minimum		Typical					
Commercial Designation	ASTM Designation	Tensile Strength, psi	Elongation, % in 2 in.	Yield Strength,[2] psi	Tensile Strength, psi	Elongation, % in 2 in.	Brinell Hardness, 500-kg load 10-mm ball	Shear Strength, psi	Fatigue Strength, psi
Sand Cast Alloys									
40E	ZG41, Aged	30,000	3.0	25,000	35,000	5.0	75	26,000	9,000
43	S1, As Cast	17,000	3.0	9,000	19,000	6.0	40	14,000	6,500
113	CS22, As Cast	19,000	Not Req'd.	15,000	24,000	1.5	70	20,000	9,000
122-T2	CG1, H.T. 1	23,000	Not Req'd.	20,000	27,000	1.0	80	21,000	9,500
122-T61	CG1, H.T. 2	30,000	Not Req'd.	30,000	40,000	<0.5	115	29,000	8,500
142-T21	CN21, H.T. 1	23,000	Not Req'd.	18,000	27,000	1.0	70	21,000	6,500
142-T61	CN21, H.T. 2	32,000	Not Req'd.	32,000	37,000	<0.5	105	32,000	8,000
195-T4	C1, H.T. 1	29,000	6.0	16,000	32,000	8.5	60	24,000	6,000
195-T6	C1, H.T. 2	32,000	3.0	24,000	36,000	5.0	75	30,000	6,500
195-T62	C1, H.T. 3	36,000	Not Req'd.	30,000	40,000	2.0	95	31,000	7,000
195-T7	C1, H.T. 4	29,000	3.0	19,000	——	——	——	——	——
214	G1, As Cast	22,000	6.0	12,000	25,000	9.0	50	20,000	5,500
B214	GS1, As Cast	17,000	Not Req'd.	13,000	20,000	2.0	50	17,000	——
220-T4	G3	42,000	12.0	25,000	46,000	14.0	75	33,000	7,000
319-F[3]	SC8, As Cast	23,000	Not Req'd.	18,000	27,000	2.0	70	——	10,000
319-T6	SC8, H.T. 2	31,000	1.5	24,000	36,000	2.0	80	——	10,000
355-T51	SC21, H.T. 2	25,000	Not Req'd.	23,000	28,000	1.5	65	22,000	7,000
355-T6	SC21, H.T. 1	32,000	2.0	25,000	35,000	2.5	80	30,000	8,500
355-T71	SC21, H.T. 3	30,000	Not Req'd.	29,000	35,000	1.5	75	——	10,000
356-T51	SG1, H.T. 2	23,000	Not Req'd.	20,000	25,000	2.0	60	18,000	7,500
356-T6	SG1, H.T. 1	30,000	3.0	24,000	33,000	4.0	70	27,000	8,000
Permanent Mold Alloys									
43	S1, As Cast	21,000	5.0	9,000	24,000	9.0	45	18,000	——
A108	SC1, As Cast	24,000	Not Req'd.	16,000	28,000	2.0	70	25,000	——
113	CS22, As Cast	24,000	Not Req'd.	19,000	28,000	2.0	70	23,000	——
122-T551	CG1, H.T. 1	30,000	Not Req'd.	35,000	37,000	<0.5	115	27,000	8,500
122-T65	CG1, H.T. 2	40,000	Not Req'd.	36,000	48,000	<0.5	140	30,000	9,000
A132-T551	SN41, H.T. 1	31,000	Not Req'd.	28,000	36,000	0.5	105	24,000	——
A132-T65	SN41, H.T. 2	40,000	Not Req'd.	43,000	47,000	0.5	125	27,000	——
138	CS21, As Cast	26,000	Not Req'd.	24,000	32,000	1.5	100	22,000	——
142-T571	CN21, H.T. 1	34,000	Not Req'd.	34,000	40,000	1.0	105	26,000	10,500
142-T61	CN21, H.T. 2	40,000	Not Req'd.	42,000	47,000	0.5	110	31,000	9,500
152-T524	CS23	27,000	Not Req'd.	16,000	29,000	1.0	95	22,000	——
B195-T4	CS4, H.T. 1	33,000	4.5	19,000	37,000	9.0	75	30,000	9,500
B195-T6	CS4, H.T. 2	35,000	2.0	26,000	40,000	5.0	90	32,000	10,000
B195-T7	CS4, H.T. 3	33,000	3.0	20,000	39,000	4.5	80	——	——
A214	GZ1, As Cast	22,000	2.5	16,000	27,000	7.0	60	22,000	——
B214	GS1, As Cast	19,000	Not Req'd.	13,000	22,000	2.0	55	——	——
319-F[3]	SC8, As Cast	28,000	1.5	19,000	34,000	2.5	85	24,000	——
319-T6	SC8, H.T. 2	34,000	2.0	27,000	40,000	3.0	95	——	——
355-T6	SC21	37,000	1.5	27,000	43,000	4.0	90	30,000	9,000
356-T6	SG1, H.T. 1	33,000	3.0	27,000	40,000	5.0	90	——	——
Die Casting Alloys									
13	S5	——	——	21,000	39,000	2.0	——	——	19,000
43	S4	——	——	16,000	30,000	9.0	——	——	17,000
85	SC2	——	——	24,000	40,000	5.0	——	——	22,000
360	SG3	——	——	27,000	44,000	3.0	——	——	19,000
A360	SG2	——	——	23,000	41,000	5.0	——	——	18,000
380	SC7	——	——	26,000	45,000	2.0	——	——	20,000
A380	SC6	——	——	25,000	46,000	3.0	——	——	19,000

[1] The alloy and temper designations and mechanical properties are those of the Aluminum Co. of America.

[2] Compression yield strength generally considered to have same value as tensile yield strength.

[3] "As-cast" temper.


METHODS OF JOINING WALLS
3T UNIFORM WALLS
BLEND
PREFERRED FORM OF RIB
BOSSES AND FLANGES
BLEND METAL AROUND BOLT BOSS
METHODS OF BLENDING METAL AROUND BOLT BOSSES
BEADS
METHOD OF BEADING CORED HOLES (DOUBLE BEAD PREFERRED)
METHOD OF BEADING RIBS
BEADING OF ALUMINUM SLEEVE
RECOMMENDED FLANGE AND BOLT HOLE PROPORTIONS
NOTE RADIUS (D/8) AT CORNER OF SPOTFACE

Suggested design details for aluminum alloy castings.

majority of foundries is predominantly in the silicon containing alloys, and it is expected that their use will continue to expand as designers recognize their superior qualities.

In this latter class are the straight aluminum-silicon alloys, the most important being the 5 per cent silicon alloys. Additions of copper to the aluminum-silicon alloys provide several variations with improved hardness and machining properties. Such alloys are usually supplied in the as-cast condition, depending on the alloying additions only for their properties. By the addition of magnesium to this alloy class, alloys capable of improved mechanical properties on heat treatment are produced.

It is such alloys that today provide the most desirable combination of casting characteristics and mechanical properties for general engineering applications. Intricate castings with thick and thin sections, and required to be free from leaks, are more readily cast in these alloys than in the aluminum-copper type alloys.

A number of aluminum alloys developed for more or less special purposes are also available in castings. In this class are the aluminum-magnesium alloys providing superior resistance to corrosion and tarnish. A heat treated 10 per cent magnesium alloy offers the highest mechanical properties available in any of the aluminum alloys, although it possesses some foundry limitations. Where properties at elevated temperatures are required, a 10 per cent copper-magnesium or a 4 per cent copper-nickel-magnesium alloy is available. Specific electrical and chemical requirements are provided by still other types of aluminum alloys.

Unfortunately no one alloy possesses, to the highest degree, all of the properties which may be desired by a designer. Also, all alloys are not equally suited to all methods of casting. Hence, the selection of an alloy for any particular application requires the careful weighing of the characteristics offered against the characteristics desired, and the establishment of a suitable compromise. The casting producers' experience can be very helpful in making this selection and should be used whenever possible. Certain general considerations with respect to the design of the casting will also minimize some of the alloy limitations.

In establishing a casting design, the process by which the part is to be cast will influence many functional design features. Among the design factors that must be considered in selecting the casting process are the uniformity of section thickness, intricacy of the shapes and cores, dimensional tolerances desired, and the surface finish required. The number of parts required and the amount of subsequent machining and finishing are also factors affecting both design and economics, and must be considered. Some of the fundamental design features applicable to all the casting processes are discussed here, and specific features of design as they affect the various casting processes will be reviewed in the discussion of the individual process.

The design engineer, by following a few general rules, can not only effect an improved structure, but

at the same time generally reduce unnecessary expense in producing a casting. Frequently the same features of faulty design that give trouble to the foundryman and result in high costs will also adversely affect the service life of the structure. Some shortcomings of poor design may be overcome by advanced foundry technique, but the design engineer cannot rely upon the foundry to produce castings with maximum soundness and mechanical properties unless some of the basic principles of the casting and solidification of metal are incorporated in his design.

One of the fundamental problems confronting the foundryman in the production of a cast shape is the establishment of a sequence of solidification so that the change in the unit volume of the metal on solidification can be compensated for satisfactorily. Risers, or metal reservoirs, are attached to the casting to provide the required feed metal and insure internal soundness of the casting itself.

Directional Solidification Factors

Proper gating, risering, pouring temperature, pouring speed, and the use of chills are some of the expedients used to obtain the required directional solidification. The designer should strive to design sections that are tapered in such a manner that they increase toward the points accessible to the feed metal. If tapered sections are not practical, a uniform section thickness should be maintained. When it is necessary to use a design in which light and heavy sections join, a gradual increase in thickness of the thinner section toward the point of junction is an advantage.

Castings containing non-uniform sections improperly filleted or tapered are prone to develop cracks as a result of residual stresses formed during solidification. Shrinkage and shrinkage cavities tend to occur in sections which are not designed to allow progressive solidification of the molten metal.

Half of large sand mold leaving molding machine.

Mechanical Properties

The mechanical properties of the aluminum casting alloys are normally based on tests of individually cast specimens having a test section of ½-in. diameter. The properties listed in Table 2 are based upon test results from such specimens . The test bar casting has been designed to provide optimum reproducible results and to reflect any changes in composition, metal handling practices, or heat treatment that may have occurred in its production.

When such specimens are poured with a casting and accompany the casting through subsequent operations, they do, therefore, provide some check on their quality. However, the properties of such separately cast test specimens do not necessarily represent the properties which would be provided by the castings and may be either higher or lower, depending on a number of factors that influence the solidification rate of the metal in the mold.

For example, test specimens machined from a heavy section of a casting may provide lower properties than the separately cast specimens because the rate of solidification is relatively slow. Conversely, the rapid solidification rate of thin sections may result in the castings having higher mechanical properties than are shown by the separately cast test specimens. This condition is not peculiar to aluminum alloys but is true in various degrees of all cast metals.

Because of the effect of rate of solidification on the mechanical properties, the properties of test specimens machined from a single casting will also vary, depending on the location from which they are taken. Many purchasing or engineering specifications recognize this factor today and require an average tensile strength and elongation of at least one specimen machined from the heaviest, intermediate and lightest section of a casting to be not less than 75 per cent and 25 per cent, respectively, of the minimum values specified for individually cast specimens.

There is no general rule by which such factors can be determined, and the engineer, through experience, must develop the proper factor to apply to the properties specified for an alloy in determining the design stress of the casting.

Heat Treatments Developed

The mechanical properties and some physical characteristics of many of the aluminum alloys can be substantially improved by heat treatment and a number of such treatments have been developed for castings, as will be evidenced by a study of Table 2. Various combinations of strength and ductility may be obtained by variations in the heat treatment procedure. In addition, some heat treatments have been specifically developed to provide improved dimensional stability by reducing stresses and growth.

These treatments are applied principally to sand and permanent mold castings, although castings produced by the plaster mold, precision investment, or centrifugal casting processes can be so treated when desired.

The limited use of heat treatment for die castings is largely due to blistering of the castings, which may occur as a result of the porosity that is inherent in the process, and the possible loss of desired dimensional accuracy.

The low specific gravity of aluminum alloys and the adverse effect of a high pouring temperature on the metal structure limit the size of sections that can be satisfactorily cast. The minimum section thickness that can be cast depends upon the size, pressure requirements, intricacy of design of the casting, alloy, and the casting process. Extremely thin sections usually require pouring at high metal temperatures, oftentimes resulting in sacrificing desirable metallurgical structure with corresponding reduction in mechanical properties. The commercial foundry practice limitations, with respect to casting section thickness, will be discussed under the various casting processes.

Ribs and Fillets

From the design standpoint, ribs and fillets are used primarily to improve the section modulus and act as stiffeners or reinforcing members. A more even distribution of the stresses from the applied service loads is realized from their correct use. The same factors influencing section thickness also govern the design of ribs. In addition to imposing casting difficulties, ribs designed too thin are subject to overstressing in the outer fibers.

Consistent with economical molding practice, beads added to the outer edges of the ribs will reduce the outer fiber stress. In cases where beads are not practical, beneficial results may be obtained by designing the ribs with square rather than rounded outer edges. The possibility of ribs containing dross or voids, which would reduce their effectiveness, will be lessened if the casting is designed so that the ribs are cast in the drag or bottom part of the mold.

Generous fillets should be provided at all intersections and should be used between ribs and their supporting sections. Fillets adjoining two sections of equal thickness should have a radius at least the equal of the thickness. If the thickness of the larger of two adjoining sections exceeds the thickness of the smaller by more than 50 per cent, a gradual blending of the lighter section to the thickness of the heavier section should be used in addition to the fillets.

From the foundry standpoint, ribs are valuable in minimizing the tendencies of large flat areas of castings to distort when cooling from the casting temperature. Fillets are also beneficial to the foundryman since they aid the flow of molten metal in the mold and minimize shrinkage and cracking. It is important for the designer to keep in mind that the improvement in section modulus which the use of ribs, fillets, and other built-up masses such as bosses or lugs is intended to provide, may be entirely lost if the design is such as to produce a metal mass that cannot be properly fed.

Locating Points

The design engineer should indicate on the drawing the locating points to be used by the machine shop in machining the casting. The same locating points can then be used by the pattern shop and the foundry to check the dimensions of the casting. The points should be as far apart as the size of the casting permits, preferably located on the same side of the parting line so that they will not be influenced by a shift of the core, the cope or the drag. Jigs are frequently used by both the foundry and the machine shop for checking dimensions, the design of such jigs being based upon the locating points or dimensions which have close tolerances and a minimum of machine finish.

Aluminum castings produced by sand casting process.

Inserting Other Metals

It is often desirable to cast inserts of other metals in aluminum castings to form wear resisting surfaces. Cast iron or steel are the most suitable materials, although copper and brass are sometimes used but require that the foundryman take proper care to prevent their solution in the aluminum. Because of the difference in coefficients of thermal expansion, the engineer should make certain that the casting design makes provision for sufficient metal around inserts to withstand the stress developed as the aluminum alloy casting shrinks during solidification.

It is also essential that the inserts be designed to have mechanical retention in the aluminum casting, as no metallurgical bond normally exists between the insert and the aluminum. Inserts to be used for transmitting high torque to the casting should have a series of slotted projecting legs or dogs spaced radially around the insert to provide the required grip in the aluminum.

Applications requiring inserts for bearing purposes or for transmittal of light torque with no repeated reversals can be satisfactorily held by the use of knurled or shallow machine-grooved "keys" on the outer surface. Any of the commonly used casting processes allow the use of cast-in inserts, but the engineer should not overlook the fact that pressed-in or shrunk-in inserts

will oftentimes suffice for bearing or bushing service and may provide a lower cost of assembly.

Design Factors—Molding and Coring Economics

Parting lines should be made as straight as possible, the cost of producing castings with an uneven parting line generally overbalancing the cost of redesign to obtain an even parting line. Deep pockets and small recesses complicate the molding and add to the cost of cleaning. Similarly, small holes should be avoided in the interest of economy, particularly if tolerances are not close enough in the cast hole and subsequent reaming or boring must be employed for the finished casting.

The ideal design of a sand casting is one that can be molded in green sand and, if a core is necessary, molded so that the pattern leaves its own green-sand core. The use of external and internal cores often adds materially to the cost of the casting; therefore, insofar as possible, parts should be designed to preclude cores, particularly internal dry-sand cores.

Both internal and external dry sand cores require anchoring to prevent shifting when the metal is poured. When practical, cores should be supported and anchored by core prints. Cores for semi-permanent mold castings are similarly supported. Holes in castings formed from core prints and necessary core vent and clean-out holes may be placed to coincide with functionally designed openings of the casting. Any unnecessary holes may be plugged or welded during finishing or machining.

Chaplets for supporting cores are sometimes necessary in addition to, or in lieu of, core prints. They should be avoided whenever possible, particularly in castings which are required to be pressure tight, since any leakage will usually occur around such chaplets.

Equipment for permanent mold casting production.

Significant economies can be realized in the cleaning and finishing costs of castings provided these operations are considered during the design. Positioning of the parting line so that removal of the gates and parting line flash can be facilitated should be kept in mind. Necessary risers for feeding heavy sections in inaccessible spots are removed with difficulty and at added expense. Unnecessary costs may be eliminated by the foundry in hand finishing operations of casting surfaces which are to be subsequently machined, if such surfaces are clearly marked on the drawing supplied to the foundry.

The design engineer is responsible for the shape of the structure and, in order for the foundryman to produce castings with maximum soundness and uniformity, the close cooperation of the designer with the foundryman is paramount. The various casting processes each offer their own potential advantages but, too frequently, the design engineer does not obtain the advantages because of failure to consult the supplier during the development of his design.

Casting Processes

It will be to every designer's advantage to consider the casting process with his other factors when developing a casting design. In short, it is easier and less costly to select an alloy and design a part to a particular process than to modify it later. The following section is intended to assist the designer in selecting the proper casting process, and to provide further engineering details about each process.

As mentioned previously, there are several casting processes adaptable to aluminum alloys, and the choice of the process best suited to any particular application depends on both technical and economic considerations in addition to the functional design requirements. Of these processes, three account for the major production, namely, the sand casting process, the permanent and semi-permanent mold process, and the die casting process. In the year 1942, the shipments of aluminum alloy castings fabricated by the sand casting process were approximately 64 per cent of the total, the permanent mold process and the die casting process accounting for about 19 and 17 per cent, respectively.[1]

The trend now being encountered for increased production by the permanent mold process is illustrated by the fact that comparable values for the year 1946 show that permanent and semi-permanent mold production increased to 39 per cent, while the sand casting production was reduced to about 41 per cent, die casting remaining about constant at 19 per cent, and the other casting processes employing aluminum accounting for the remaining 1 per cent.[1]

Sand Castings

The sand casting process is the most versatile method of casting, primarily because of its universal adaptability. This process is generally employed for the production of (1) small quantities of identical castings; (2) parts requiring intricate coring; (3) large castings; and (4) castings of a design suitable to modern

[1] *Facts for Industry*, Bureau of Census, Industry Division, Department of Commerce.

high speed molding equipment where production costs lower than for other methods can be established. Sand castings weighing from a few ounces to 500 lb are commonly produced, while castings up to 7,000 lb have been made.

A suitable pattern, incorporating the required allowances for shrinkage and subsequent finishing, is employed in this process to produce the expendable sand mold. When dry-sand cores are required, core boxes and driers are generally necessary. Such equipment has somewhat lower initial cost than equipment for certain of the other processes discussed later, but at the same time also provides a more limited life. Production rates are controlled by the type of pattern equipment as well as the molding equipment, and may be from a few parts per hour for large castings using loose pattern equipment, to several hundred per hour for small castings using metal matchplate equipment.

Determining Section Thickness

The minimum section thickness that can be cast in sand depends on the size, pressure requirements, and intricacy of the design of the casting. Although sections on the order of $\frac{1}{8}$ in. have been produced in small castings, $\frac{3}{16}$ in. is generally considered the minimum for small and medium sized parts.

Some sand castings are cast with sufficient accuracy so that no machining or finishing is required for their ultimate use over that normally done as a finishing operation by the foundry. The size tolerance is affected by the size of the casting, type and accuracy of pattern equipment, and molding technique. The designer can expect extremely close tolerances only with highly specialized production items, and then generally with cost of the finished casting proportionally higher.

Tolerances of $\pm \frac{1}{32}$ in. are practical for small castings, but greater tolerances are required for large castings. Closer dimensional tolerances are normally obtained by machining, and finish allowance for such machining is necessary. Normal practice is to provide about $\frac{1}{8}$ in. for such finishing on small and medium sized castings. Large castings usually require $\frac{1}{4}$ in. or more finish allowance, particularly on those surfaces cast in the cope of the mold. The engineer should, wherever possible, design the casting so that surfaces which are to be machined can be cast in the drag of the mold.

The physical characteristics of the sand, the quality of the pattern surface, and the molding technique primarily govern the surface smoothness of sand castings. Although relatively smooth surfaces can be obtained with fine sand, the use of such sand is limited to rather small castings, larger castings requiring somewhat coarser sand in order to provide the increased mold permeability necessary for better casting soundness.

Aluminum sand castings have better surface smoothness than sand castings of the heavier metals. Since the requirements of surface smoothness of the casting will influence its cost, the engineer should consider the necessity of specifying excessively smooth finish.

Permanent Mold Castings

In the permanent mold process, metal molds and cores are used, the metal being poured into the mold cavity under a normal gravity head. Semi-permanent mold casting is a variation of this process, and greatly

Examples of aluminum castings produced by the permanent mold and semi-permanent mold casting process.

expands the use of the process by virtue of the use of dry sand cores, thus overcoming many of the design limitations imposed by metal cores. Collapsible steel cores may be employed in certain cases to provide irregular or undercut cored surfaces.

Permanent and semi-permanent mold parts weighing from a few ounces to 20 lb are common foundry products, although permanent mold parts weighing up to 250 lb and semi-permanent mold castings weighing up to 500 lb have been produced. Permanent mold castings are characterized by their metallurgical superiority, pressure tightness, superior surface finish, closer dimensional tolerances and, for certain sizes or design, speed of production and cost per piece.

Chill Effect of Metal Mold

The metallurgical superiority of this process is due to the chill imposed by the metal mold, consequently providing a refinement of grain and reduction in porosity in the castings. This results in a substantial improvement in the strength over similar parts cast in sand. The casting of a properly designed part in a well engineered metal mold is also conducive to the formation of favorable thermal gradients in the mold, allowing progressive solidification of the molten metal.

Pressure tightness of the castings is one of the characteristics that result from such favorable conditions in a permanent mold. Many applications demand this quality, and may influence the decision of a designer to select the permanent mold process.

Mold equipment for permanent molds is usually constructed from a good grade of dense cast iron, the cavities being machined to the desired contour. Metal

cores, when required, are usually machined from alloy steel. Sand cores for semi-permanent molds are of the same general type as used for sand castings and require the same production equipment. The cost of such molds will depend on the complexity and the casting tolerances desired.

Normally, this cost exceeds that of good sand casting pattern equipment, but can be justified where production requirements are sufficient. The usual practice is for the casting purchaser to pay for the original mold equipment, and the foundry to provide any necessary maintenance or replacement molds. This practice, of most permanent mold producers, makes a further inducement to the design engineer to consider the permanent mold process.

As with sand castings, it is difficult to define the minimum section thickness which can be provided by the permanent mold process because of the effect of size and intricacy of the casting. Although sections of the order of $\frac{1}{10}$ in. can be provided in certain castings, $\frac{1}{8}$ in. is usually considered the minimum. The minimum diameter of cored holes is considered $\frac{3}{8}$ in., but holes as small as $\frac{1}{4}$ in. diameter are possible in some cores.

The surface finish of permanent mold castings is governed by the smoothness of the mold surfaces and the proper control of mold coatings, the use of such coatings being essential to this process. The finish is superior to that provided by sand castings and can generally be used without further processing. Surfaces produced by sand cores in semi-permanent mold castings are dependent upon the smoothness of the core.

Permanent Mold Tolerances

Possible tolerances depend on the size and complexity of the casting, and the location of the dimension involved with respect to moving members of the mold. Tolerances lower than those possible with sand castings are generally provided, $\pm$ 0.020 in. being commonly maintained for small castings. Tolerances are usually figured as $\pm$ $\frac{1}{64}$ in. for the first one inch or less, plus 0.001 to 0.002 in. for each additional inch of length, depending on whether the dimension is affected by moving parts of the mold.

Permanent mold castings also permit reduced machine finish allowances because of the closer tolerances and smoother surface finish. Depending on the size of the castings, finish allowance of $\frac{1}{32}$ in. to $\frac{1}{16}$ in. is generally adequate. Draft allowances should be as generous as possible, with 1 to 2 degrees considered as minimum and 3 to 5 degrees as preferred. Metal cores must also be supplied with draft; however, the minimum and preferred draft may be about one-half of those just quoted. The required tolerances and draft greatly affect the cost of a casting because of their influence on production rates.

Favorable costs for permanent mold castings are more apparent when a large number of identical parts are produced, the cost of the mold being distributed to a greater number of parts. Low costs are apparent in certain size or design of casting because of increased production rates per man-hour. Potential savings in machining and finishing may even provide economies for small production runs sufficient to warrant the use of this process.

Die installed in cold chamber die casting machine.

Die Castings

Ability to cast relatively thin sections, accuracy, uniformity of reproduction, and low costs per piece characterize the die casting process. In the production of die castings, molten metal is injected into a metal mold or die under pressure. Air injection up to about 750 psi is utilized in the so-called "gooseneck" machines, whereas the "cold chamber" machines, employing metallic plunger injection, use pressures of 3,000 to over 20,000 psi.

Today, die casting equipment suitable for production of castings ranging from a fraction of an ounce to 20 lb is available. Castings have been produced whose overall dimensions are 36 x 12 x 9 in., but castings with dimensions in one direction may exceed these, as castings up to 84 in. have been produced.

Heat treated alloy steel dies are required for the production of aluminum alloy die castings, the engineering of which is best done by trained designers experienced with aluminum. Although the cost of this equipment may exceed that required for the other casting processes, it is usually justified when sizeable quantities of parts are required. The cost is offset by the high productivity of the process and the elimination of finishing and machining operations . As in the case of permanent molds, die casting foundries normally provide maintenance and replacement equipment when necessary.

Consistent with the size and complexity of the casting, the alloy used, and the required strength and rigidity, relatively thin and uniform sections are desirable in die castings. Castings having a major dimension of 6 in. can be produced with sections of 0.045 in. in thickness, while for castings whose largest dimension is 15 in., a section thickness of 0.080 in. is about minimum. Although larger castings require somewhat heavier sections, thicknesses in excess of 0.150 in. are seldom required for the casting process.

Die Casting Tolerances

Because of the close tolerances usually desired in die castings, designers of such parts should consult the producer for exact tolerances with respect to each casting being designed. In this way maximum advantage can be taken of the process in providing close tolerances where required without complicating the production

of the casting. Generally speaking, tolerances as low as 0.0015 in. per linear inch, but not less than 0.002 in. on any dimension can be maintained. On large castings, this tolerance can be further reduced to 0.0010 in. for each additional inch over 10 in.

An additional tolerance of from 0.003 to 0.010 in. is generally allowed on the plus side for dimensions affected by the parting line of the die or other moving parts of the die. Flatness tolerances are generally determined by multiplying the longest dimension by 0.0015 in.

Metal cores may be used in this process to produce recesses and holes. Frequently such coring will reduce or entirely eliminate machining operations, at a saving to the user. At the same time, such cores will make for lighter castings with superior metallurgical properties as a result of the increased chill provided by the steel cores. Holes from $\frac{1}{10}$ in. to over 1 in. in diameter or cross section can be provided within certain depth limitations with proper draft allowance. External threads down to about 24 threads per inch can also be cast within certain tolerances.

The possible surface detail and surface finish of die castings is superior to that of any other form of aluminum casting. Most commercial die castings can be used with a minimum of finishing operations, attention to the surface of the casting at the parting line being generally all that is required. Faithfulness of reproduction of engraved or ornamental details is an outstanding advantage of this process.

Die casting production rates will vary with the size and intricacy of the casting and dies, alloy, and size of machine used, large machines operating more slowly than small machines. Operating speeds up to 150 cycles per hour may be attained with both gooseneck and cold chamber machines if the part being produced is simple and the die of small or medium size. Frequently, multiple cavity dies can be designed to permit increased piece production per cycle.

Die castings have very favorable costs compared with those of permanent mold castings, and frequently with sheet stampings, when large quantities of identical castings are involved. Substantial savings can be realized in metal costs due to the lighter unit weight permitted by the thinner sections. The dimensional accuracy, smooth surfaces, and ability to cast threads and core holes also makes for minimum finishing costs. In fact, excessive machining is undesirable since it will result in reduced strength with removal of the chilled surface skin.

Other Refractory and Metal Mold Castings

Several additional casting processes adaptable to aluminum alloys are available. In most cases these processes are modifications of previously discussed casting methods, being developed to provide improved casting tolerances. Small precision castings requiring a minimum of machine tool man-hours for finishing may be produced by these methods. Although the initial cost of such castings is frequently higher than that of castings produced by the more common processes, the higher cost may be offset by savings in finishing. Plaster mold, precision investment, and centrifugal castings may, therefore, provide characteristics desired by the designer for certain of the specialty type castings.

Aluminum castings produced by die casting process.

Plaster mold casting is a refinement of the sand casting process in which the normal molding sand is replaced by other non-metallic materials, such as gypsum plaster, with the result that smoother mold surfaces and greater mold accuracy are possible. The plaster mold must be heated prior to use to drive off the water and is capable of producing but one casting, after which it is discarded. The process is generally confined to small castings under about 2 lb in weight, although considerably larger castings have been produced.

Since precision is the primary advantage of this process, metal matchplate pattern equipment, and metal core boxes when necessary, must have greater accuracy than that required for sand castings. Therefore, the costs are greater than for similar sand casting equipment, but generally less than that required for permanent mold castings. Mechanical molding equipment is oftentimes used for large quantity production items, with resulting production rates about comparable to those of the permanent mold process. Normally, a gravity head is employed in pouring such molds, although moderate pressures are sometimes applied after pouring to obtain improved casting detail.

Effect on Mechanical Properties

The mold materials generally used with this process provide a slower solidification of the metal than in normal sand or metal molds. This results in lower mechanical properties and tends to promote segregation of the alloying constituents. To minimize these disadvantages, aluminum-silicon alloys are generally employed in this process. A combination of the superior fluidity of the aluminum-silicon alloys and the nature of the mold material provides the opportunity to obtain a smooth surface finish and thin sections.

Precision investment casting also utilizes a nonmetallic type mold, generally gypsum plaster, but employs an expendable wax pattern produced in a master mold instead of the usual permanent pattern. The wax pattern is completely enrobed or invested in the molding material and is subsequently melted out of the mold after having formed the required cavity.

The heating required for melting out the wax pattern is generally combined with the necessary operation of removing the excessive water from the plaster itself,

this being required to put the plaster in a condition to receive the molten metal. Castings of this type are usually poured under pressure, or use of the centrifugal process or vacuum to supply pressure immediately after the metal is poured.

Accuracies approaching those of die castings are possible with this process in many cases, and because there are no moving mold or die members to interfere, accuracies in other cases may be superior. The use of pressure to fill the mold cavity also insures a sharpness of detail commensurate with that of die casting; subsequent machining of these castings is generally reduced to a minimum.

Because most castings produced by this method are of very small size and light section, the effect of the slow cooling imposed by the mold is not sufficient to greatly affect the mechanical properties or alloy choice. Although most of the aluminum casting alloys can be used for small castings, the aluminum-silicon alloys are preferred for larger sized castings.

Centrifugal casting utilizes centrifugal force in a revolving mold to fill the mold cavity. This process has been popular with various ferrous and non-ferrous alloys because of the cleansing of the metal of oxides and inclusions by the centrifugal action and the resulting improved mechanical properties. Similar separation of inclusions in aluminum castings by the centrifugal action is limited because of the small differences in specific gravity between the various oxides and inclusions associated with aluminum alloys and the molten metal.

Limited Use of Centrifugal Process

It is questionable, therefore, whether improved mechanical properties can be provided over those obtained by the normal casting procedures. Centrifugal casting of aluminum alloys has seen limited use up to the present time, and it remains to be shown whether the process offers anything other than a means of pouring metal under pressure.

A true centrifugal casting is one which is substantially symmetrical about an open center, and is produced from a mold which is rotated about a central axis. Semi-centrifugal catsings are also rotated about the central axis, but the mold contains a central core used to form the contour of the bore.

Centrifuged castings are unsymmetrical or without a central hole and are rotated in a horizontal plane along the perimeter of a circle concentric with the axis of rotation. Sand, molding plaster, or metal molds may be used for all three types of centrifugal castings, although the strength limitations of sand molds limit their use. Metal molds are preferred for high production, but plaster molds are commonly used for small castings.

Mold equipment for centrifugal castings is essentially the same as for similar molds used for comparable gravity casting processes, and the cost of such equipment should be similar. The maximum size of casting produced appears to be limited only by the strength of the mold material and the centrifugal casting machine. To date most production has been in small castings.

Depending on the smoothness of the mold surface, centrifugal castings should have surface smoothness and sharpness of detail superior to that of castings produced in similar mold equipment under gravity. The outstanding advantage appears to be the possibility of casting thin sections at low metal temperature, a condition favorable to mechanical properties.

Conclusions

Properties and inherent characteristics of the aluminum alloys themselves account for the use of aluminum castings for many applications, but in other cases the several commercial processes by which such alloys can be cast provides important economic advantages. In order to realize these advantages to the maximum, the basic casting design limitations, together with the advantages and disadavantages peculiar to each of the casting methods, should be considered during the early stages of casting design. It cannot be overemphasized that, during all stages of design, close cooperation between the design engineer and the producing foundry is essential.

References

Peter Blackwood and John Perkins, "Centrifugal Castings," TRANSACTIONS, American Foundrymen's Association, vol. 52, pp. 273–312 (1944).

CAST METALS HANDBOOK, 1944 Edition, American Foundryman's Association.

Casting Alcoa Alloys, Aluminum Company of America (1947).

Herbert Chase, "Which Form of Nonferrous Casting?," *Metals and Alloys,* vol. 18, Sept. 1943, p. 496.

Design Details for Aluminum, Aluminum Co. of America (1944).

Robert Neiman, "Precision Casting by the Investment Molding Process," TRANSACTIONS, American Foundryman's Association, vol. 52, pp. 349–383 (1944).

Process Control of Aluminum Foundry Procedure, Progress Report No. 1, S.A.E. War Engineering Board of the Society of Automotive Engineers, Inc., Feb., 1945.

H. J. Rowe and W. E. Sicha, "Cast Aluminum Alloys Heat Treatment," AMERICAN FOUNDRYMAN, Aug., 1946, and TRANSACTIONS, American Foundrymen's Association, vol. 54, pp. 424–435 (1946).

Alfred Sugar, "Permanent Mold Castings," *Metals and Alloys,* vol. 21, April, 1945, pp. 1016–1028.

L. F. Swoboda, "Light Metal Permanent Mold Castings," *Iron Age,* vol. 154, Dec. 28, 1944, p. 56.

Fashion Show and Tour on Ladies Entertainment Agenda At Convention

PRELIMINARY PLANS for the Ladies Entertainment Program of the 52nd Annual Meeting of A.F.A. have been announced by H. J. Williams, New Jersey Silica Sand Co., Millville, N.J., head of the Convention committee on arrangements for the ladies.

Highlights include a fashion show and tea at Wanamaker's store, Tuesday, May 5; a motor tour of historic Philadelphia sites Wednesday morning, and a visit to the world-famous Franklin Institute that afternoon; and an all-day motor trip to Valley Forge, Thursday.

Friday, of course, the ladies will attend the Annual Banquet, climax of the five-day Congress and Show of 1948.

The ladies will register at the Benjamin Franklin Hotel, Monday, May 3.

Co-chairman and members of the committee are: Mrs. C. W. Mooney, Jr.; Mrs. M. B. Valentine; Miss Irene Gocher; Mrs. W. D. Bryden; Miss Dorothea M. Thum; Mrs. C. W. Thompson; Mrs. E. C. Benkert; and Mrs. K. S. Matz.

SYNTHETIC RESIN BINDERS

Application in the Foundry Industry

Howard C. Frisbie
Foundry Engineer
E. F. Houghton & Co.
Philadelphia

SYNTHETIC RESINS OR PLASTICS ARE NOT NEW. They were first developed approximately 40 years ago and have continued to find new applications in industry since that time. Their first introduction into the foundry as thermosetting core binders occurred about 27 years ago. At that time manufacturing costs prohibited their acceptance in the coreroom.

Since then new developments, new marketing outlets and mass production have brought them more into line with average binder costs. They were again brought into the foundry during the early part of World War II and, when properly applied, met with immediate success. Many foundrymen readily agree that synthetic resin core binders were an important factor in helping them meet production schedules which had mushroomed to gigantic proportions.

These new binders have continued to keep pace with the increased demand for castings and are proving to be of great value to the foundrymen in our present post-war economy. In some cases they not only have eliminated the troublesome jobs but also have been adopted 100 per cent in the core room and extended to standard production.

A few of the outstanding advantages and characteristics of synthetic resin core binders which continue to hold the interest of many foundrymen are:

1. "Bake-out" completely in approximately one half the time required for oil type binders. To put it another way, they automatically double core oven baking capacity.
2. Resist overbaking, due to a flatter baking curve.
3. Reduce shakeout time.
4. Decrease scrap castings caused by hot cracks or tears.
5. Reduce gassing and rejects due to gas.
6. Resist metal penetration by providing sufficient hot strength where required.

During the development of synthetic resin dry core binders it was soon recognized that in their original form they did not constitute the perfect core binder. Their principal disadvantages were odor, stickiness in core box, storage life and critical baking temperature.

Powdered Resins

In order to minimize and control these factors, the resins have been compounded with other materials and are available to the coremaker in the form of dry powders. As such they are complete binders, often requiring only sand and tempering water to make a satisfactory core mixture. However, cereal, silica flour, kerosene, etc., may be used with them in the same manner and for the same reason that such assisting agents are used with oil type binders.

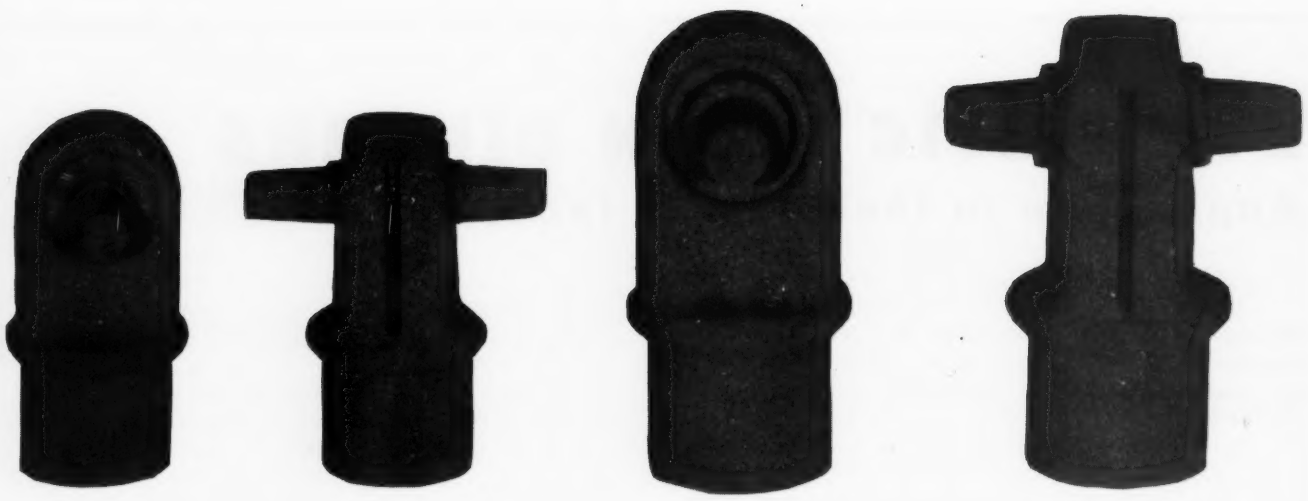
The urea-formaldehyde type of core binders have been applied primarily in core mixtures for aluminum, magnesium, thin-section malleable and gray iron. This is because of their rapid collapsibility, low retained strength and ability to bake-out at lower temperatures.

Core Collapsibility

An example of each of these applications has been demonstrated in Eastern foundries. One case was in a magnesium foundry making round hand grenades in a semipermanent mold. The core was 3 in. in diameter surrounded by a metal wall thickness of only $\frac{3}{16}$-in. The only outlet for core removal was a $\frac{1}{2}$-in. print hole. Oil cores refused to break up because of the low heat content of the thin-section magnesium walls. The same core made with urea-formaldehyde poured out like dry sand after rapping the casting once against a wooden barrel. In this case shakeout time was reduced by approximately 80 per cent—the casting surface was improved and the baking capacity of the ovens doubled.

An aluminum foundry making boot molds had the same experience removing a core weighing 10 lb, 4-

Testing "bake-through" of cores. Left—Properly baked core. Right—Core was not baked through.



Typical cores made with resin type dry core binder.

in. diameter and 24-in. length through a single 5/8-in. opening. Today these cores are being rapped out with a rubber mallet instead of the former practice of placing on vibrating boards for shakeout.

A malleable iron shop had difficulty completing an order for 6-in. "T" fittings. Its problem was cracked castings. In order to make the core more collapsible wood flour and other materials had been tried with the oil binder until the core was so weak it could not be placed in the mold without falling apart in handling. Synthetic resin cores were made and, although they appeared to be much too hard, the core sand poured out of perfect castings.

Although the urea-formaldehyde resins offer several important desirable properties as core binders, one disadvantage, which is the disagreeable odor when the molds are poured, should be recognized. However, the odor may be minimized to a large extent by reducing the amount of binder in the core mixture to a minimum; by baking a little longer or placing hoods with exhaust vents over the section of the molding room where they are poured.

The fact that many foundries have continued to use urea type binders in regular production for the past 5 years provides evidence that the odor problem can be handled. In many cases it has proved economical to make a few changes in order to obtain the advantages of the urea-formaldehyde core binders.

Dry-binder cores produced in coremaking machine and ready for baking in dielectric core ovens.

Successful Applications

The phenol-formaldehyde type of dry core binder has been applied more successfully to the gray iron, steel, brass and bronze foundries. It has several outstanding features, namely:

1. It provides cores with a higher hot strength and advantages of:
   (a) Resistance to metal penetration and burn-in.
   (b) Reduction of knockout time.
   (c) Reduction of clean-up time.
   (d) Improvement of casting finish.
2. It eliminates odor and irritating acrolein fumes during the baking and pouring operations.
3. Bake-out completely in one half the time required for oil type binders.

A large gray iron foundry has used the phenol-formaldehyde type of binder for several years on a roll casting 6 ft long by 18 in. in diameter. When made with oil sand the cores were baked overnight. Now when the planning department forgets to schedule these large cores and issues a last minute rush order to the core room, the foundry gets the cores within 3½ hr. Casting finish is improved and smoke entirely absent when the molds are poured.

A bronze foundry making fittings has found it can bake ½-in. to 8-in. cores in one half the former baking time. This has doubled oven capacity, and it was apparent that a much better finish on the casting was obtained, saving many hours in the clean-up departments.

Results reported from several steel foundries all show the same improvement over the conventional binders formerly used.

Experience has shown that best results are obtained with synthetic resin core binders when dry sand is available. The correct mixing procedure then would be as:

OHIO FOUNDRY CONFERENCE SCHEDULED FOR MARCH 11-12

AN OHIO Regional Foundry Conference is being sponsored jointly by the five A.F.A. Ohio chapters—Northeastern Ohio, Central Ohio, Canton District, Cincinnati District and Toledo—Northwestern Pennsylvania and Case Institute of Technology, Cleveland, on Thursday and Friday, March 11-12, in Cleveland. Technical sessions during the two days will be held at Case.

The conference committee, under the general chairmanship of Northeastern Ohio Chapter Vice-Chairman Elmer C. Zirzow, National Malleable & Steel Castings Co., Cleveland, has arranged a tentative program (shown here) intended to cover important phases of foundry practice. This will include individual technical sessions devoted to gray iron, malleable, steel, non-ferrous and patternmaking subjects on Thursday and Friday morning, with a general meeting to be held Thursday morning.

Plant Visitations Scheduled

Two luncheons also are being planned, while a reception and dinner will be held Thursday evening at the Cleveland Club. Other features of the program include plant visitations and an inspection of Case Institute, one of the six engineering schools where foundry engineering training is being conducted in cooperation with the Foundry Educational Foundation.

Members of the executive committee in charge of conference arrangements include, in addition to Mr. Zirzow, the following: Frank C. Cech, Cleveland Trade School; George K. Dreher, Foundry Educational Foundation; Vincent J. Sedlon, Master Pattern Co.; David Clark, Forest City Foundries Co.; William G. Gude, Penton Publishing Co.; Robert D. Walker, Werner G. Smith Co.; F. Ray Fleig, Smith Facing & Supply Co.; Gerald M. Cover, Case Institute of Technology, all of Cleveland and Howard C. Gollmar, Elyria Foundry Div., Industrial Brownhoist Corp., Elyria, Ohio.

Rooms have been set aside at the Tudor Arms Hotel, Cleveland, for out of town guests but members and guests are urged to contact the hotel before March 8 for reservations. Luncheons and banquet will be held at this hotel which is within walking distance of Case. Rooms are also available at other Cleveland hotels since there are no conventions in the city during this period.

The conference program is as follows:

Thursday, March 11

9:00 am—Registration

10:30 am—Opening Meeting
CHAIRMAN, H. C. Gollmar
Welcoming Addresses: Prof. K. H. Donaldson, Case Institute of Technology; Mayor Thomas A. Burke; Wm. W. Maloney, A.F.A. secretary-treasurer, Chicago.
Recent Developments in the Foundry Industry, F. G. Steinebach, Penton Publishing Co., Cleveland.

12 noon—Luncheon
(To be followed by conducted tours of Case Institute)

2:30 pm—Gray Iron
CHAIRMEN, J. G. Goldie, M. B. M. Foundry Inc., Garfield Heights, Ohio, and F. W. Fuller, National Engineering Co., Columbus, Ohio.
Some Modern Trends in Cupola Operation, Thaddeus Giszczak, research metallurgist, A.F.A. Cupola Research Committee.

2:30 pm—Steel
CHAIRMEN, T. D. West, West Steel Casting Co., Cleveland and Prof. Gerald M. Cover, Case Institute of Technology.
Recent Metallurgical Developments, Dr. C. H. Lorig, Battelle Memorial Institute, Columbus.

2:30 pm—Malleable
CHAIRMAN, Earl M. Strick, Erie Malleable Iron Co., Erie, Pa.
Cracks in Ferrous Castings, Their Causes and Possible Remedies, by B. C. Yearly, National Malleable & Steel Castings Co., Cicero, Ill.

2:30 pm—Non-Ferrous
CHAIRMEN, Walter Bonsack, Apex Smelting Co., Cleveland, and Walter J. Klayer, Aluminum Industries, Inc., Cincinnati, Ohio.
Commercial Aluminum Casting Alloys, Walter E. Sicha, Aluminum Co. of America, Cleveland.

2:30 pm—Patternmaking
CHAIRMAN, V. J. Sedlon
DISCUSSION LEADER, F. C. Cech
Casting in Plaster, Morris Bean, Morris Bean & Co., Yellow Springs, Ohio.

4:00 pm—Education
CHAIRMEN, F. C. Cech and George K. Dreher.
Apprenticeship, Short Term Training, or Both?, J. G. Goldie.
What the University Contributes to Foundry Industrial Training, Prof. K. H. Donaldson.
Foundry Educational Foundation, G. K. Dreher.

6:00 pm—Reception and Banquet.

Friday, March 12

9:45 am—Gray Iron
CHAIRMEN, H. J. Trenkamp, Ohio Foundry Co., Cleveland, and A. D. Barczak, Bardes Forge & Foundry Co., Cincinnati.
Casting Defects, W. B. McFerrin, Electro Metallurgical Co., Detroit.

9:45 am—Malleable
CHAIRMAN, J. J. Witenhafer, Columbus Malleable Iron Co., Columbus.
Effect of Boron on Malleablization of White Iron, Joseph Micksch and H. A. Fabert, Case Institute of Technology.

9:45 am—Steel
CHAIRMEN, T. D. West and I. M. Emery, Massillon Steel Casting Co., Massillon, Ohio.
Hot Tears in Steel Castings, C. W. Briggs, Steel Founders' Society of America, Cleveland.

9:45 am—Non-Ferrous
CHAIRMEN, Walter Bonsack and C. F. Bunting, Pitcairn Co., Barberton, Ohio.
Brass and Bronze Foundry Practice, H. L. Smith, Federated Metals Div., American Smelting & Refining Co., Pittsburgh.

9:45 am—Patternmaking
CHAIRMAN, V. J. Sedlon.
Patternmaking—Past, Present and Future, Ernest T. Kindt, Jr., Kindt-Collins Co., Cleveland.

11:00 am—Gray Iron
CHAIRMAN, J. G. Goldie.
Mechanization in the Foundry, R. G. McElwee, Vanadium Corp., Detroit.

11:00 am—Malleable
CHAIRMAN, Edward Bossert, Maumee Malleable Castings Co., Toledo, Ohio.
Modernization and Malleable Melting Practice, W. R. Jaeschke, Whiting Corp., Harvey, Ill.

11:00 am—Steel
CHAIRMEN, T. D. West and Prof. D. C. Williams, Ohio State University, Columbus.
Steel Sands and Economy of Mixes, C. A. Sanders, American Colloid Co., Chicago.

11:00 am—Non-Ferrous
CHAIRMEN, Walter Bonsack and G. N. Wright, John Harsch Bronze & Foundry Co., Cleveland.
Electronic Baking of Foundry Cores, J. W. Cable, Induction Heating Corp., New York.

11:00 am—Patternmaking
CHAIRMAN, V. J. Sedlon.
Plastics as Used in Patternmaking, Ladd Salach, Plastic Corp. of Chicago, Chicago.

12:30 pm—Luncheon.

2:30 pm—Plant Visitations.

ACICULAR CAST IRONS

Committee Report
The Institution of Mechanical Engineers
London, England

ACICULAR CAST IRONS are now well established and provide a range of mechanical properties superior to those of other types of high-duty cast irons hitherto available. The tensile strength in the as-cast condition may be varied between 20 and 35 tons per sq. in., and this may be further markedly increased from 25 to 40 tons per sq. in. by a simple thermal treatment at about 320 C (608 F) for 5 to 12 hr; this also serves as a stress-relief treatment. The transverse rupture stress varies from about 40 to 65 tons per sq. in., and this is likewise improved to 70 tons per sq. in. by thermal treatment.

Shock Resistance

The acicular cast irons are notable for their high resistance to shock and impact, a standard stress-relieved test piece giving values between 25 and 50 ft-lb, whereas a high-duty pearlitic iron rarely exceeds 25, with an ultimate tensile stress of 23 to 25 tons per sq. in. and corresponding transverse rupture stress of 37 to 39 tons per sq. in. and deflection of 0.23 in. and 0.14 in. for standard 1.2 in. and 0.875 in. bars. The Brinell hardness of acicular irons varies from 250 to 400, the higher figures being associated with the higher tensile strengths. The thermal treatment, however, while not reducing the Brinell hardness, gives a pronounced improvement in machinability.

To attain a high level of mechanical properties, the procedure and composition of the metal must be carefully controlled in accordance with the procedure given in the following paragraphs.

Results given in the report have been obtained, except where specifically stated otherwise, in the laboratories and experimental foundry of the British Cast Iron Research Association, in some cases by crucible-melting and in others by cupola-melting, as indicated. These furnaces are experimental only in the sense that they melt small quantities of metal, as compared with industrial practice, but in all cases commercially practicable compositions and methods of treatment have been used and results of commercial melts indicate that the experimental results are comparable. Indeed, there is reason to believe that results obtained on a manufacturing scale may be superior, due to the larger quantities of metal involved.

Test Procedures

Test results have been obtained in all cases by previously published procedures, the mechanical tests in particular in accordance with British Standard Specifications Nos. 321 and 786. Throughout, the term T is used for ultimate tensile stress in tons per sq. in., R for transverse rupture stress in tons per sq. in., S for shock or impact strength in ft-lb on a 0.798 in. cylindrical, unnotched bar, and H for Brinell hardness, taken in accordance with British Standard Specification No. 240. Deflection in inches in transverse is given as D, and elastic modulus, in millions of pounds per sq. in., as E.

Acicular Structure—The classification of cast irons given as Fig. 1 of the Committee's 1941 Report on Special Duty Cast Iron,* shows four types of engineering gray cast iron: ferritic, pearlitic, martensitic, and austenitic. The bulk of engineering cast irons are pearlitic or of mixed ferrite-pearlitic structures, but by appropriate modification to composition, austenitic, or alternatively martensitic, structures may be obtained.

Both these types are used only for special purposes, as indicated in the report. The characteristic structure and properties of the acicular irons justify their inclusion as a separate class, for any engineering purposes requiring the properties they possess although, as shown in the following, they must not be regarded as having properties at elevated temperatures in excess of those of the pearlitic high-duty irons.

All these special structures of cast iron may be obtained from pearlitic cast iron by appropriate heat-treatment (as will be illustrated), but in general it is more satisfactory to obtain them by means of specified amounts of certain alloy additions.

Solidification Sequence

As explained in the earlier report, a plain cast iron begins to solidify as austenite, which precipitates graphite as it cools and, at about 740 C (1,364 F), undergoes a constitutional change from austenite to pearlite, a eutectoid mixture of cementite and ferrite. If the rate of cooling is increased, the temperature of transformation tends to be lowered and finer pearlite, or ultimately martensite, is formed.

In a casting of given section poured in a sand mold, the rate of cooling is usually fixed, but the effect of a lowered transformation temperature and more sluggish transformations may be secured by certain alloy additions, and these can be arranged to give an austenitic structure in the cold (i.e., a transformation temperature below air temperature), with fairly heavy additions, or alternatively (with smaller additions) a martensitic structure. By still smaller additions, but in excess of those which would be made to improve a pearlitic iron with the intention of retaining that structure as such, it is possible to obtain a needle-like struc-

* An alphabetical list of references is given at end of paper.

Note: From a preprint of the Fourth Report of the Research Committee on High-Duty Cast Iron for General Engineering Purposes. The Institution of Mechanical Engineers, prepared by *Committee Reporter* J. G. Pearce.

TABLE 1—CHEMICAL ANALYSES

Component	Percentage Composition						
	A	B	C	D	E	F	G
Total carbon...	3.02	2.62	3.0-3.2	3.00	2.30	2.86	2.91
Silicon.....	1.54	2.39	1.8-2.2	—	2.32	1.95	2.03
Manganese....	0.91	1.01	—	0.44	—	0.67	0.77
Sulphur.....	0.04	0.10	—	0.08	—	0.06	0.06
Phosphorus....	0.04	—	< 0.2	0.04	—	0.09	0.08
Nickel.....	Nil	1.25	1.3-2.0	2.12	2.03	—	2.10
Chromium.....	Nil	0.20	0.2-0.35	—	—	0.12	0.15
Molybdenum..	Nil	0.46	0.65-1.0	1.01	1.31	0.79	0.69
Copper.....	—	—	—	—	—	1.86	—

ture which resembles martensite in some ways, but which is nevertheless machinable and has improved mechanical properties.

From this needle-like constituent, the material is usually termed "acicular cast iron." Since the section of the casting influences the rate of cooling, which in turn governs the ultimate structure (and which it is the aim of all these procedures to control), it follows that within broad limits the additions required to yield the acicular structure need to be adjusted to suit the section or range of sections being made in one foundry at one time.

Cast iron strength is governed by two main factors—the quantity and distribution of the graphite, and the strength of the metal matrix in which the graphite is embedded. It will be clear from the following that there is a limit to the improvement rendered possible by the reduction of graphite in a flake-graphite iron, because there is a lower limit to total carbon content below which founding properties suffer (Third Report, 1943), and hence further improvement must arise from improvement of the metallic matrix. It is to this improvement of the metallic matrix that the superior properties of acicular cast irons must be attributed.

Composition Range

It is proposed to outline the range of the normal elements of composition in acicular cast irons, and then to deal with the special effects of the necessary alloy additions, severally and conjointly. This will enable the ideal composition for a given section to be determined, and its accompanying mechanical properties to be indicated. First, however, the effect of heat-treating a pearlitic iron is shown.

Heat-Treated Pearlitic Irons—Pearlitic cast irons can be improved in tensile strength to values associated with the acicular irons. An engineering cast iron of analysis A, Table 1, was cast in the form of 1.2-in. and 0.875-in. bars and tested in the as-cast condition. Similar bars were oil-quenched from 900 C (1,650 F) and tempered for 2 hr at 450 C (840 F). Test results are given in Table 2. They show a marked increase in tensile strength, but a reduction in other properties. The cost and complexity of the heat-treatment render the use of alloy additions preferable, and the risk of distortion or minute cracking from such a drastic treatment is avoided. The pearlite was structurally replaced by tempered martensite.

Development of the Acicular Structure—As previously shown, nickel produces a purely martensitic structure in sufficient amount, but it has been known for some years that molybdenum (in amounts below 1 per cent) could produce a relatively soft acicular constituent giving superior mechanical properties, while it was also found that the simultaneous addition of nickel assisted in the formation of the acicular structure.

Thus, in 1937, MacPherran reported tensile strengths of over 31 tons per sq. in. from a composition B in Table 1. The Brinell hardness of this was 302, appreciably lower than most quenched and tempered irons of similar strength. The very low carbon content would make it suitable for very large castings only. No details of the structure were given in this paper, but there is little doubt that it would be acicular.

The commercially-made iron reported in the First Report (Table 19) in 1938 had a partially acicular structure, as had some of the commercial materials given in the Third Report. Roth (1939) reported strengths of 26 to 34 tons per sq. in. from iron of the range of compositions given at C, Table 1. The structure of these irons was shown and was acicular, and the various quench and temper heat-treatments were tried, the best being an oil quench from 840 C (1,544 F) followed by tempering for one hour at 320 C (608 F). The tensile strength was 41 tons per sq. in.

Flinn and Reese (1941) reported a tensile strength of 36.6 tons per sq. in. for an iron in the as-cast state of composition E in Table 1, and these investigators discovered the remarkable improvement resulting from a low temperature heat-treatment. After 15 hr at 320 C (608 F) the strength of this iron was raised to 43.8 tons per sq. in., and the highest value recorded was nearly 47 tons per sq. in. The work was experimental in that melts were made on a small scale in the induction furnace, and the carbon content given is too low for commercial castings and would be impracticable from a commercial cupola furnace.

The same investigators also demonstrated that in larger section sizes the slower cooling rate inhibited the formation of the acicular structure, but by increasing the nickel content to 5 per cent for a 4-in. section it could be retained. Details relating to alloy content, section size and heat-treatment, to develop the acicular structure in cast irons, have been incorporated in a patent (British) held by the Mond Nickel Co., Ltd.

Castings were also produced in England containing nickel and molybdenum to give an acicular structure, which under service conditions gave remarkable life.

In confirming these results and carrying out the present program, it was found that high-duty acicular cast irons could be produced by alloy combinations of

TABLE 2—MECHANICAL PROPERTIES: HEAT-TREATED IRON

Iron A, Table 1	1.2-in. Diameter Bars		0.875-in. Diameter Bars	
	As-Cast	Quenched and Tempered	As-Cast	Quenched and Tempered
Transverse rupture stress, R, tons, per sq. in.....	40.8	26.4	39.0	23.3
Deflection (transverse), D, in.....	0.37	0.20	0.18	0.11
Ultimate tensile strength, T, tons per sq. in.....	24.2	33.2	25.8	35.6
Shock or impact strength, S, ft-lb.....	20	15	19	17
Brinell hardness No., H	210	329	224	356

copper and molybdenum, which are also responsive to the low temperature heat-treatment, for thinner sections, and by combination of nickel and copper with molybdenum in heavier sections.

In the plain cast irons, the normal elements of composition present, due to the nature of the raw materials employed, are carbon, silicon, manganese, sulphur and phosphorus.

Total Carbon Content—Part of the carbon present in cast iron is there as carbide of iron, and this is said to be combined carbon. The balance is free carbon or graphite. The amount of total carbon allowable in a modern high-duty iron is fixed within fairly narrow limits, the lower because of the need for castability and for avoiding unduly high shrinkage, and the higher because of the adverse effect on strength of a high graphite content. The melting furnace commonly employed, the cupola, has been proved to be highly effective for producing acicular cast irons if carefully controlled, and the highest qualities are made from it.

On account of the high shrinkage of low-carbon iron it is undesirable to go below 2.7 per cent and, indeed, it is rare for the cupola to produce a lower-carbon material. Conversely, on account of the diminishing strengths of irons progressively increasing in carbon, it is undesirable to exceed 3.1 per cent and, as the upper limit applies to smaller and the lower to larger castings, the range is too narrow to permit experimental variation for the purpose of ascertaining the effect on properties. For the present investigation, the aim was a total carbon content of about 2.9 per cent.

High-duty irons are normally made today by melting in the cupola furnace charges high in steel scrap or refined pig iron (to keep down the carbon content of the metal). The low carbon and relatively low silicon contents, and the high melting temperature tend to produce a special variety of fine graphite, usually termed undercooled, arising from the breakdown of iron initially solidifying white.

It is usual to add to the molten metal as it comes from the furnace a so-called ladle graphitizer (Third Report) or inoculant, such as ferro-silicon, ferro-silicon plus nickel, calcium silicide or proprietary material. This suppresses the tendency to form white iron and hence ensures the presence of graphite in the flake form. As these materials frequently add a small amount of silicon to the melt, the silicon in the charge material is adjusted accordingly.

TABLE 3—MECHANICAL TESTS: SILICON VARIATIONS

Treatment	*R*, tons per sq. in.	*D*, in.	*T*, tons per sq. in.	*S*, ft-lb.	*H*, Brinell No.	Silicon, per cent
As-cast	40.4	0.35				
	45.2	0.46	21.4	37	285	1.67
Tempered	50.2	0.39				
	46.5	0.34	—	32	288	
As-cast	47.1	0.44				
	41.6	0.39	25.4	28	321	2.22
Tempered	50.3	0.36				
	49.4	0.35	24.9	28	328	
As-cast	42.2	0.42				
	43.8	0.47	23.5	29	313	2.86
Tempered	47.5	0.37				
	48.1	0.38	26.0	24	300	
As-cast	41.3	0.43				
	42.6	0.44	21.8	29	290	3.20
Tempered	46.4	0.39				
	47.6	0.39	25.4	25	295	

TABLE 4—CHEMICAL ANALYSES: PHOSPHORUS VARIATIONS

Cast	Total Carbon	Combined Carbon	Silicon	Manganese	Sulphur	Phosphorus	Nickel	Molybdenum	Chromium
A	2.94	0.63	2.14	0.78	0.02	0.03	1.50	0.93	0.18
B	2.88	0.94	2.14	0.80	0.03	0.19	1.46	0.94	0.16
C	2.88	0.77	2.05	0.84	0.03	0.35	1.49	0.94	0.16
D	2.85	0.52	2.09	0.80	0.03	0.51	1.46	0.95	0.16
E	2.86	0.93	2.08	0.84	0.03	0.74	1.45	0.94	0.16
F	2.80	0.63	2.08	0.84	0.03	0.90	1.41	0.92	0.16
G	2.77	0.83	2.08	0.80	0.03	1.14	1.45	0.91	0.18

Silicon—The silicon content is also adjusted to the size and section of the casting, but the range in high-duty irons seldom goes below 1.6 per cent or exceeds 2.6 per cent. As the ladle graphitizer mentioned previously may add 0.3 to 0.6 per cent to the melt, the range in the charge material may be 1.0 to 2.3 per cent. Experiments have been made to see whether variations in silicon content affect the strength and structure of acicular irons, and the answer is negative.

Silicon Variations

In dealing with necessary variations in silicon, therefore, no adverse effects need be feared. These tests were made on crucible-melted material and hence the strengths recorded are rather low. The chemical analysis of the metal for elements other than silicon is given at D in Table 1, and mechanical properties in Table 3, on 1.2-in. bars. In several of these tables, figures are given for the as-cast and tempered states to illustrate the improvement due to thermal treatment, which experiment showed was most advantageous at 300 to 350 C (572 to 662 F) for 5 hr, plus one hour for each inch of section above 2 in., followed by slow cooling.

Manganese and Sulphur—As manganese and sulphur exist mainly as manganese sulphide (an inclusion which does not materially affect the properties or structure) it is only necessary to ensure that the manganese is adequate to neutralize the sulphur content. For a maximum sulphur content of 0.15 per cent, the manganese should not be below 0.55 per cent and should be somewhat in excess—say, 0.6 to 0.9 per cent, and no great disadvantage arises if it should be still higher. A manganese content of 0.5 per cent should be regarded as a minimum for any sulphur content, as in melting processes there is a slight loss of manganese by oxidation.

Phosphorus is usually kept low in high-duty irons, below 0.15 per cent for Grade 4, and below 0.3 for Grade 3 of British Standards Specification No. 786. In fact, 0.3 per cent corresponds to maximum tensile strength, but the impact strength is reduced as phosphorus increases, as shown in the Second Report. In order to determine its effect on acicular structure, a 300-lb crucible furnace melt was made and bars were poured.

Successive increasing additions of ferro-phosphorus were made until seven sets of bars were cast, ranging in phosphorus from 0.03 to 1.14 per cent. The analyses are given in Table 4, and the mechanical properties in

Table 5, on 1.2-in. and 0.875-in. bars. Calcium silicide was used as a ladle graphitizer, and bars were tested as-cast and after thermal treatment for 5 hr at 320 C (608 F).

For the best combination of mechanical properties the phosphorus should be kept as low as possible, preferably below 0.15 per cent for the highest properties, and in any case below 0.3 per cent. The phosphorus forms a compound with molybdenum and this robs the matrix of an essential constituent, as shown by Rote and Wood (1945). Thus an acicular iron containing 0.7 to 1.0 per cent molybdenum becomes pearlitic with a phosphorus content of 0.6 to 0.8 per cent. Nickel appears to be able to offset this effect of phosphorus to some extent, although even in this case the mechanical properties are reduced.

Special Elements of Composition

Nickel, copper, chromium, and molybdenum are frequently added to high-duty irons, and molybdenum is an essential constituent of the acicular irons, as is nickel, although it can to some extent be replaced by copper in thin sections.

Molybdenum—A series of melts from the British Cast Iron Research Association experimental cupola, cast into 1.2 in. bars and thermally treated for 5 hr at 320 C (608 F), show that little is gained by increasing the molybdenum content above 0.8 per cent. Table 6 gives the results. In general, the molybdenum should be kept within the range of 0.7 to 0.1 per cent; provided, as indicated previously, that phosphorus is low.

TABLE 5—MECHANICAL TESTS: PHOSPHORUS VARIATIONS

Treatment	Cast	Diameter, in.	*R*, tons per sq. in.	*D*, in.	*E*, psi. x10⁶	*T*, tons per sq. in.	*H*, Brinell No.	*S*, ft-lb.
As-cast	A	1.2	50.6	0.44	16.5	28.4	321	
Tempered		1.2	60.4	0.42	17.3	30.0	350	
As-cast	A	0.875	45.3	0.23	16.3	28.8	363	24
Tempered		0.875	63.0	0.27	17.2	30.3	363	
As-cast	B	1.2	43.8	0.35	16.9	27.3	309	
Tempered		1.2	49.4	0.31	17.3	24.4	339	
As-cast	B	0.875	42.8	0.20	16.8	29.9	392	15
Tempered		0.875	43.5	0.18	16.7	31.4	395	
As-cast	C	1.2	44.2	0.35	16.1	24.3	325	
Tempered		1.2	41.6	0.30	17.2	29.1	373	
As-cast	C	0.875	43.6	0.16	16.5	29.0	380	13
Tempered		0.875	49.5	0.19	17.6	34.2	398	
As-cast	D	1.2	35.2	0.26	15.0	25.8	390	
Tempered		1.2	36.1	0.29	15.3	26.0	388	
As-cast	D	0.875	36.8	0.12	16.8	26.4	367	11
Tempered		0.875	42.5	0.16	17.0	25.8	383	
As-cast	E	1.2	35.3	0.28	17.1	23.1	359	
Tempered		1.2	33.8	0.21	18.0	26.2	385	
As-cast	E	0.875	35.4	0.15	16.7	23.7	394	9
Tempered		0.875	41.4	0.15	17.4	25.8	393	
As-cast	F	1.2	36.3	0.27	18.2	22.4	345	
Tempered		1.2	36.4	0.22	16.4	24.4	339	
As-cast	F	0.875	39.3	0.12	16.3	25.3	390	7
Tempered		0.875	41.3	0.11	17.3	26.3	415	
As-cast	G	1.2	32.6	0.26	18.5	19.9	321	
Tempered		1.2	35.0	0.19	18.5	20.3	329	
As-cast	G	0.875	33.1	0.11	16.4	20.6	388	7
Tempered		0.875	40.4	0.14	16.9	21.0	398	

Nickel and Copper—The value of nickel in acicular cast irons has been well treated by MacPherran, Roth, and Flinn and Reese. Irons containing 2 per cent nickel, 0.75 per cent molybdenum, and 0.15 per cent chromium have given tensile strengths of 40 to 50 tons per sq. in. after thermal treatment, but were extremely hard. The present work has shown that for the thinner sections copper may be used as an alternative, but the limited solubility of copper makes its exclusive use impracticable in heavy sections.

Nickel facilitates the production of the acicular structure in sections in which the slower cooling rate would otherwise yield pearlite. Nickel in excess of the amount required to yield the acicular structure will give martensite, which will give increased hardness and reduced machinability. The following procedure is recommended, based on the examination of bars made by casting varied sections up to 6-in. diameter:

Nickel Contents

0.5 per cent to 1.5 per cent for sectional thicknesses up to 1.5 inches.

1.5 per cent to 2.5 per cent for sectional thicknesses between 1.5 inches and 3 inches.

2.5 per cent to 3.0 per cent for sectional thicknesses between 3 inches and 4 inches.

3.0 per cent to 4.0 per cent for sectional thicknesses between 4 inches and 8 inches.

Over 4.0 per cent for sectional thicknesses over 8 inches.

Copper Contents

Copper can be used as an alternative to nickel in sections up to 1.5 inches in like amounts (i.e., 0.5 per cent to 1.5 per cent). Maximum strength in these sections is given by up to 3.0 per cent copper, but at the expense of machinability. For larger sections with more nickel, not more than 1.5 per cent nickel can be safely replaced by copper.

Material made in the British Cast Iron Research Association experimental cupola is given in Table 7, with mechanical results in Table 8.

Chromium—Melts carried out both in the experimental cupola and in a manufacturing scale furnace have shown that chromium in excess of 0.4 per cent is harmful to the development of the acicular structure and that the element should preferably be below 0.2 per cent. The compositions and properties are given in Table 9, the heat-treatment being carried out on 1.2-in. bars at 320 C (608 F) for 5 hr.

Acicular Structure Affected

Vanadium is a carbide-stabilizing element, like chromium, and its frequent occurrence in foundry pig irons and scrap renders a study of its effect in acicular irons desirable, in view of the results obtained for chromium.

The effect of vanadium on the acicular structure was studied, initially by five melts with varying molybdenum and nickel contents calculated either to yield an acicular structure or to be just insufficient to do so. Additions of vanadium were made progressively by means of ferro-vanadium. All the melts showed an increase in hardness, and structurally no positive con-

clusions could be drawn, but in borderline cases the vanadium tended to prevent the formation of acicular ferrite and in acicular structures to promote the formation of a low-temperature transformation product formed below the normal austenite-pearlite change, but above the temperature of the acicular change. The mechanical tests reflected these results.

A further test was made with an acicular iron containing 0.7 per cent molybdenum and 1.6 per cent of nickel. Additions of ferro-vanadium were made to give vanadium contents up to 0.8 per cent, and the bars were tested both as-cast and after the recommended heat-treatment to 320 C (608 F) for 5 hr followed by slow cooling in the furnace.

Vanadium Additions

Structurally, the vanadium-free melt was acicular ferrite, without pearlite, but with vanadium a low-temperature transformation product appeared and increased, and then, with increasing vanadium, troostite and lamellar pearlite. The hardness increased by some 15 Brinell points for each 0.1 per cent vanadium addition. The tensile strength and impact resistance fell with the higher vanadium additions due to the partial structural change caused by the vanadium addition.

Vanadium additions up to 0.8 per cent cause the replacement of the soft acicular ferrite by a hard low-temperature transformation product, and with the higher additions this forms a complex structure with troostite and lamellar pearlite. There is a trend toward higher strengths with this structural change before the weakening effect of the mixed structure predominates, but the hardness is increased and the machinability impaired. Stronger and harder acicular structures may be obtained if required by adjusting the amount of other alloys (e.g., molybdenum or nickel) without recourse to the mixed structures consequent on vanadium additions.

While, therefore, the amount of vanadium normally present in pig irons and scrap need not cause any difficulty in making acicular cast irons, specific vanadium additions should be avoided.

Effect of Gases and of Section Size

Tests were carried out to ascertain whether gases likely to be met in melting and founding processes, hydrogen, nitrogen, or carbon dioxide, had any effect on the acicular structure, but it was found that such gases did not in any way interfere with the formation of the acicular structure, and that there was no appreciable effect on transverse or tensile strength, hardness or shock-resistance.

Effect of size of section can only be shown within a limited range of bar diameters because of the limitations of testing machine capacity. The tensile strength and hardness of bars cast between 1.2 and 2.1 in. is shown in Table 10, the analyses being given at F and G of Table 1.

The change in strength with section, even for the same composition, is comparatively small, and if the recommendations given in the foregoing with respect to modifying composition to suit action size are carried out, no serious difference in strength between heavier and lighter sections need be anticipated. The importance of ensuring the acicular structure may be judged from the following example, Table 11, giving tests taken from 2.1-in. bars representing a heavy casting and having rather too low a molybdenum content to ensure a fully acicular structure.

Two bars were tested, and one had a good acicular structure while the other had a normal pearlitic structure. The first bar had better mechanical properties, wholly on account of the acicular structure, and had

TABLE 6—MOLYBDENUM

Total Carbon	Silicon	Manganese	Sulphur	Nickel	Molybdenum	Chromium	*T*, tons per sq. in.
2.82	1.84	0.62	0.14	1.95	0.73	0.24	40.8
2.91	2.27	0.84	0.15	2.14	1.21	0.35	37.4
2.95	2.27	0.87	0.15	1.69	1.86	0.23	36.8

TABLE 7—COPPER

Component	Percentage Composition A	B	C
Total carbon	2.91	3.01	2.97
Silicon	1.78	1.83	1.91
Manganese	0.71	0.81	0.77
Sulphur	0.10	0.11	0.09
Phosphorus	0.03	0.03	0.19
Copper	0.59	0.97	1.97
Molybdenum	0.62	0.93	0.78
Chromium	—	—	0.14

TABLE 8—COPPER

		R, tons per sq. in.	*D*, inches	*T*, tons per sq. in.	*H*, Brinell Nos.	*S*, ft-lb.
A	As-cast	54.0	—	26.5	277	22
A	Heat-treated	58.7	—	32.7	280	26
B	As-cast	50.3	0.38	24.6	277	63
B	Heat-treated	70.6	0.51	31.7	285	59
C	As-cast	—	—	25.8	335	—
C	Heat-treated	—	—	38.5	320	—

TABLE 9—CHROMIUM

Percentage Composition							Properties		
Total Carbon	Silicon	Manganese	Phosphorus	Nickel	Molybdenum	Chromium	*R*, tons per sq. in.	*T*, tons per sq. in.	*S*, ft-lb
3.00	1.88	0.81	0.11	1.68	0.64	0.38	56.0	39.6	36
2.92	2.25	0.96	0.14	1.73	0.64	0.53	46.9	28.6	25
3.02	1.88	0.94	0.09	1.73	0.78	0.78	38.6	28.5	15
3.04	2.14	0.87	0.08	1.89	0.74	0.94	43.0	28.4	20

TABLE 10—SECTION SIZE

	1.2 In.		1.6 In.		2.1 In.	
	As-cast	Tempered	As-cast	Tempered	As-cast	Tempered
Metal F: *T*, tons per sq. in.	28.4	38.7	25.9	26.3	24.8	37.1
Metal F: *H*, Brinell No.	321	307	295	282	256	247
Metal G: *T*, tons per sq. in.	30.7	40.0	27.4	35.6	26.8	32.6
Metal G: *H*, Brinell No.	390	396	315	302	295	287

TABLE 11—SECTION SIZE

Bar	Percentage Composition								Properties			
	Total Carbon	Silicon	Manganese	Sulphur	Phosphorus	Nickel	Chromium	Molybdenum	*R*, tons per sq. in.	*D*, in.	*T*, tons per sq. in.	*H*, Brinell No.
1	2.99	2.14	1.15	0.08	0.09	2.37	0.35	0.43	46.5	0.46	24.2	330
2	3.02	2.61	1.07	0.08	0.10	2.40	0.32	0.51	34.8	0.28	17.3	266

this bar received the normal thermal treatment, the results would have been appreciably better. The better deflection indicates the increased toughness.

Test results shown in Table 12 were obtained by the Mond Nickel Co., Ltd., on material cast in a commercial foundry. The material was cast from one melt of composition: total carbon, 2.89 per cent; silicon, 1.82 per cent; manganese, 1.10 per cent; sulphur, 0.06 per cent; phosphorus, 0.04 per cent; nickel, 2.85 per cent; chromium, 0.08 per cent; molybdenum, 0.80 per cent. The heat-treatment was 6 hr at 340 C (644 F). All bars were machined to 1.128-in. diameter for the tensile test and to 0.798-in. diameter for the impact test. The hardness tests were Vickers diamond.

This material is calculated by analysis to suit castings represented by a bar 4 in. in diameter, and hence the smaller bars are harder than would be found in practice in castings with compositions suited to these smaller bar diameters. In another case a casting independently analyzed to give a composition not differing greatly from the foregoing, and intended for a 4-in. maximum section size, gave over 35 tons per sq. in. on a tempered 1.2-in. bar and was easily machined with a high speed tungsten steel.

Strength at Elevated Temperatures

Information obtained with respect to the strength of acicular irons in the cold requires to be supplemented by a knowledge of their behavior at elevated temperatures. These irons are not specifically required to withstand, and are not recommend for, service at elevated temperatures, but nevertheless many engineering castings become heated in service.

Pearlitic irons have their essential constituent formed at 720 to 600 C (1,328 to 1,112 F), and are known to be stable up to 400 to 500 C (752 to 932 F). Martensitic irons have their essential constituent formed at 100 to 250 C (212 to 482 F) and are known to be unstable under heat, as shown by their response to tempering. Acicular structures are formed at temperatures between those of pearlite and martensite.

Short time tests at elevated temperatures have been taken on acicular irons. They show a behavior in line with that of ordinary pearlitic iron in that there is little reduction in strength up to 400 C (752 F), but a rapid decline after that. It seemed desirable, however, to determine what structural change takes place on heating, and hence four acicular irons and two pearlitic irons were annealed for various periods at 750, 700, and 650 C (1,382, 1,292, 1,202 F) to determine the rate of breakdown of the acicular structure.

Mechanical tests in this section were carried out in the cold after exposure to elevated temperatures. The analyses and mechanical tests in the cold are given in Table 13 for the six melts of crucible-made material, on 1.2-in. bars, all of which had a similar base analysis except that two acicular irons had a silicon of 2.0 per cent and two of 1.5 per cent. Microscopic examination showed that the appropriate structures had been obtained in each case, and a series of preliminary pilot tests was carried out.

Results of the more comprehensive subsequent examination may be summarized thus: the acicular irons rapidly changed in structure at temperatures of the order of 600 to 750 C (1,112 to 1,382 F) and the carbides assumed the spheroidal form, as did the carbides of the (unalloyed) pearlitic irons. The mechanical tests taken on the pearlitic irons confirmed previous findings in that the tensile strength and hardness diminished with annealing time and increased in impact strength.

Tests taken on the acicular irons showed that they were similar to what might have been expected from alloyed cast iron in the pearlitic condition. In other words, acicular cast irons cannot be expected to maintain their special mechanical properties at temperatures at which the structure is likely to break down.

It is provisionally suggested that acicular irons should not be used at temperatures fluctuating, intermittent or permanent, in excess of 300 C (572 F), and generally should be regarded as not superior to high-duty pearlitic irons at elevated temperatures, it being understood that neither type is intended as a heat-resisting iron. However, the alloy content, close grain and hardness of the acicular irons give them the maximum degree of resistance that the structure permits.

Summary

Acicular cast irons show mechanical properties, and particularly toughness or shock-resistance, well in excess of the best high-duty cast irons hitherto known, and hence offer considerable promise for high-duty engineering purposes.

In general, they can be produced in any type of melting unit, cupola, arc-furnace, induction furnace or crucible furnace, but where the amount required is sufficient the cupola is recommended, as, composition for composition, the cupola is adequate for gray irons of total carbon content not lower than 2.7 per cent.

The recommended composition for normal elements is as follows, although it will be understood that the acicular structure may be obtained with compositions outside this range, which covers engineering high-duty cast irons:

Total carbon ..... 2.7 to 3.1 per cent.
Silicon ..... 1.6 to 2.6 per cent.
Manganese ..... 0.6 to 0.9 per cent.
Sulphur ..... 0.15 per cent maximum.
Phosphorus ..... 0.15 per cent maximum.

It is necessary to inoculate the molten metal with a ladle graphitizer, and if ferro-silicon (75 per cent silicon) or similar proprietary material is used, it should

be added in quantity yielding an additional 0.3 to 0.6 per cent silicon in the molten metal. The silicon in the charge materials will require to be reduced by like amount.

For alloying elements, the composition should be as follows:

Molybdenum: 0.7 to 1.0 per cent added as crushed or powdered ferro-molybdenum to the ladle during or immediately after pouring.

Nickel: 0.5 to 1.5 per cent for section thickness up to 1.5 in.

Nickel: 1.5 to 2.5 per cent for section thickness between 1.5 and 3 in.

Nickel: 2.5 to 3.0 per cent for section thickness between 3 and 4 in.

Nickel: 3.0 to 4.0 per cent for section thickness between 4 and 8 in.

Nickel: over 4.0 per cent for section thickness over 8 in.

Nickel: can be added to the cupola charge as F ingot, or as F shot in the ladle during or after tapping.

TABLE 12—SECTION SIZE

Bar Diameter	Properties				
	R, tons per sq. in.	*D*, inches	*T*, tons per sq. in.	*S*, ft-lb	*H*, Brinell No.
2.1 in. — As-cast	45.6	0.34	27.6	28	342
Tempered	52.7	0.33	30.8	32	359
3 in. — As-cast	—	—	25.1	25	319
Tempered	—	—	30.3	31	314
4 in. — As-cast	—	—	28.7	37	316
Tempered	—	—	28.4	27	315

Amounts below one per cent can be added cold to the ladle, but above this it should be preheated.

Copper: Nickel in sections up to 1.5 in. may be replaced by its equivalent in copper, but the amount of copper should not exceed 1.5 per cent. In sections needing more than 1.5 per cent nickel, the first 1.5 per cent may be of copper and the remainder nickel. Copper can be added to the cupola charge as massive copper scrap, or to the ladle, preferably preheated.

Chromium: Below 0.3 per cent.

Vanadium: No addition should be made.

Alternatively, cupola charges should consist of steel scrap, hematite and/or refined iron, with such low-phosphorus return scrap as may be available. Silicon and manganese can be adjusted by massive lumps of ferro-silicon and ferro-manganese in the charge. In furnaces other than the cupola, the charge composition will be as dictated by the required final composition.

Founding properties of acicular irons are similar to those of other irons of similar carbon and silicon content. The casting should not be stripped until it is cool, and never while it is above 300 C (572 F), unless accelerated cooling in large castings is necessary to economize in alloy additions.

The casing should be treated at 300 to 350 C (572 to 662 F) for 5 hr plus 1 hr for each 1 in. of section size above 2 in., and cooled slowly. The heat-treatment improves the machinability without affecting hardness appreciably, and considerably improves the mechanical properties.

Acicular cast irons will give tensile strengths of 25 to 40 tons per sq. in. and transverse strengths of 40 to 70 tons per sq. in. The lower the total carbon, the higher will be the strength. For a given section and carbon content, the higher strengths are obtained with higher nickel contents, but this higher strength will be accompanied by increased hardness—both property increases being due to the formation of martensite.

For maximum strength the nickel or copper should be as high as possible; for a maximum machinability the nickel or copper content should be as low as is consistent with obtaining the acicular structure. Acicular cast irons have excellent shock-resistance, two or three times that of a high-duty pearlitic iron. Measured on a cylindrical unnotched bar, strengths of 25 to 50 ft-lb may be expected, when tested on the standard Izod impact testing machine.

Properties for Engineering Purposes

In considering the mechanical properties of acicular cast irons for engineering purposes, less stress should be laid upon the maximum tensile strengths obtainable than upon the fact that they offer a range of cast irons having mechanical properties in excess of those normally obtainable from the pearlitic irons. In many cases it is more important to ensure a tensile strength in the region of the highest limit indicated in British Standard Specification No. 786, than to aim at high figures which may not be obtained with certainty.

Application—Acicular irons proved to be of exceptional value during the war for shell forging dies, stamping dies for light alloys and other non-ferrous metals and steels, cast camshafts and crankshafts for petrol and oil engines and compressors, lathe tool shanks and other machine tool components where high strength coupled with high shock-resistance and good damping properties are required. The thermal treatment, by relieving casting stresses, gives them excellent stability and freedom from distortion on machining.

Thus, shell dies for 25-pounder shells gave a life of 4 to 10 times that of good quality engineering iron,

TABLE 13—CHEMICAL ANALYSES AND MECHANICAL PROPERTIES

Bar	Percentage Composition									Properties		
	Total Carbon	Combined Carbon	Graphitic Carbon	Silicon	Manganese	Sulphur	Phosphorus	Nickel	Molybdenum	*T*, tons per sq. in.	*S*, ft-lb	*H*, Brinell No.
1	3.08	0.76	2.32	2.00	0.96	0.05	0.05	1.54	0.81	22.6	31.0	298
2	3.04	0.75	2.29	2.00	0.93	0.04	0.04	1.06	0.78	23.9	34.6	257
3	3.07	0.85	2.22	1.53	0.96	0.04	0.05	1.56	0.77	21.9	31.8	297
4	3.13	0.80	2.33	1.53	0.92	0.04	0.05	1.04	0.81	23.4	33.0	271
5	3.12	0.63	2.49	1.88	0.96	0.04	0.05	—	—	17.5	20.6	197
6	3.12	0.95	2.17	1.51	0.92	0.04	0.05	—	—	19.0	21.2	188

one example giving an output of 62,000 forgings compared with an average of 8,000 for gray iron dies.

Acknowledgments

The experimental work by the British Cast Iron Research Association, under the direction of the Reporter, has been carried out by H. Morrogh and J. W. Grant.

Research Committee on High-Duty Cast Irons for General Engineering Purposes

Professor A. L. Mellanby, D. Sc., LL.D., Wh. Ex., Hon. M.I. Mech. E., *Chairman.*

J. G. Pearce, M. Sc., M.I. Mech. E., *Reporter.*

Professor Gilbert Cook, D. Sc., M.I. Mech. E., F.R.S.

S. F. Dorey, C.B.E., D.Sc., Wh. Ex., M.I. Mech. E. (*Member of Council*).

Sterry B. Freeman, C. B. E., M. Eng., M.I. Mech. E.

Albert Fogg, M. Sc., A.M.I. Mech. E.

Sir William T. Griffiths, D. Sc.

G. A. Hankins, D. Sc. (Eng.), Wh. Ex., M.I. Mech. E.

Arthur Hoare, Wh. Ex., M.I. Mech. E.

J. E. Hurst, D. Met., M.I. Mech. E.

Sir William A. Stanier, M.I. Mech. E., F.R.S. (*Past President*).

E. C. Toghill.

Bibliography

Flinn, R. A., and Reese, D. J. 1941 *Transactions,* American Foundrymen's Association, vol. 49, p. 559, "The Development and Control of Engineering Gray Cast Irons."

MacPherran, R. S. 1937 *Transactions,* American Foundrymen's Association, vol. 45, p. 343, "Cupola High Test Cast Iron."

1938 *Proceedings,* I. Mech. E., vol. 140, p. 163, First Report of the Research Committee on High-Duty Cast Irons for General Engineering Purposes.

1941 *Proceedings,* I. Mech. E., vol. 146, p. 61, Second Report of the Research Committee on High-Duty Cast Irons for General Engineering Purposes. Addendum, 1943.

1941 *Proceedings,* I. Mech. E., vol. 146, p. 67, Reports on Austenitic and Martensitic Special Duty Cast Iron.

1943 *Proceedings,* I. Mech. E., vol. 149, p. 103, Third Report of the Research Committee on High-Duty Cast Irons for General Engineering Purposes.

Rote, F. B., and Wood, W. P. 1945 *Transactions,* American Society for Metals, vol. 35, p. 402, "Segregation of Molybdenum in Phosphorus-Bearing Alloyed Cast Irons."

Roth, E. I. 1939 *Transactions,* American Foundrymen's Association, vol. 47, p. 873, "Sixty Thousand Pound Per Square Inch Cupola Iron."

Institute of British Foundrymen Honors Secretary Makemson

Institute of British Foundrymen members have honored their secretary, Tom Makemson, for 21 years' outstanding service to the Institute and for service to his country during the war when he was deputy collector of Iron and Steel Control and eventually director of Iron Castings. Mr. Makemson received an inscribed silver tea service and a check.

The presentation was made by IBF President P. H. Wilson at a luncheon and special meeting of the Institute, January 16, at the Waldorf Hotel, London. Many messages of congratulations were received by Mr. Makemson from friends and colleagues all over the world. Included was a cable from A.F.A. recognizing his contributions to international good will.

V. C. Faulkner, Editor, *The Foundry Trade Journal (London)*, and President of the International Committee of Foundry Technical Associations, of which Mr. Makemson has been secretary since its formation in 1926, presented him with a bound volume of congratulatory telegrams from the members of the Committee. Special tribute came from the French foundry industry in the form of two addresses by Vincent Delport, A.F.A. representative on the Committee, on behalf of the French Association Technique de Fonderie and the Syndicate Generale de Fonderie de France. The first named association also sent an inscribed wallet.

Sir Arthur Fleming, Director of Research and Education, Metropolitan-Vickers Electrical Co., Ltd., paid tribute to Makemson before delivering a lecture on "The Inter-relation of the Engineering and Metallurgical Industries." D. Howard Wood, immediate past President, IBF, and Sir John Duncanson also spoke.

P. H. Wilson, President, Institute of British Foundrymen, congratulating Tom Makemson on completition of 21 years of service as secretary of the Institute at a luncheon held in London, January 16. Left to right, D. Howard Wood, immediate past President, IBF; Mr. Makemson; Wr. Wilson; Sir John Duncanson; G. Lambert, Assistant Secretary, IBF.

PLACEMENT PLANS REVEALED BY EDUCATIONAL FOUNDATION

PLACEMENT PLANS for college students interested in summer work, cooperative work and positions as graduates have been announced by the Foundry Educational Foundation. The Foundation will attempt to place students in foundries interested in developing men for management positions. Recommended as a basic training program for graduate engineers in the foundry industry is the A.F.A. preprint 47-37 entitled, "Foundry Training Course for College Graduates" which has been sent to member foundries of the Foundation. This two-year training program in combination with that outlined in "Cooperative Education," which appeared in the August 1947 issue of AMERICAN FOUNDRYMAN, have been adopted and are recommended by the Foundry Educational Foundation.

Through summer and cooperative work, a recent Foundation bulletin explains, a student can reduce his graduate training period. This training period, likened to a medical internship, is considered very important as a means of acquainting students with commercial foundry operations and techniques.

Inplant training of graduate engineers is being stressed to the foundry industry because of comments from industry representatives, university officials, and engineering college students. Summarized, these comments are:

From Management — Graduates are too anxious to become executives and to progress beyond their real ability. Students must understand that they have much to learn before they are ready for responsible positions.

From University Officials—Graduates need an indoctrination into professional life. Learning the present "know how" is as important as learning the fundamentals.

From Students—Training is essential to getting your feet on the ground. The company with a training program gives evidence of being well organized. This is in contrast to the company which tells the graduate, "You just work. We'll straighten that out later."

Students and companies are being canvassed by means of convenient forms to get information on the number and types of positions open, the number of students available and the work in which they are interested. These forms are available through the Foundry Educational Foundation, 1009 Public Square Building, Cleveland 13, Ohio.

Choice of Positions

The form to be filled in by college seniors includes a section listing fields of foundry practice and students are asked to indicate three choices for the field of foundry operation they would like to be in at the end of five years.

Members of the Foundry Educational Foundation shortly will receive data on graduating engineers who have shown interest in the industry. These men have become interested in the foundry industry through recent intensified publicity given to the foundry as a place in which to seek a career. In addition to graduates, the forthcoming data will include college placement counselors who can be consulted for advice on interviewing graduates.

Making it possible to hold the FEF annual meeting on the occasion of the annual meeting of the American Foundrymen's Association, the Foundation's code of regulations was amended at an FEF meeting February 12 in Cleveland.

Below is a tabulation of contributions as of November 14, 1947. This money, plus the additional amount called for in the three-year budget, will finance the FEF program in the following six schools: Cornell University, Ithaca, N.Y.; Massachusetts Institute of Technology, Cambridge; Case Institute of Technology, Cleveland; University of Cincinnati, Cincinnati; Northwestern University; and University of Wisconsin, Madison. Concentration of FEF membership is shown by the columns headed Number of Members and Percentage of Membership.

The original goal of $280,000 for financing the Foundry Educational Foundation has been met. By January most of this sum had been received in cash and the remainder

(Continued on Page 84)

State	No. of Members	% of Membership	Amt. of Contrib.	% of Contrib.	Approx. Contribution per Member
Ohio	137	26.5	$78,384	27.5	$ 572
Michigan	60	11.6	59,403	21.6	990
Illinois	53	10.02	33,666	12.2	635
Wisconsin	40	7.75	20,686	7.5	517
New York	55	10.60	20,223	7.3	367
Pennsylvania	41	8.00	11,136	4.1	272
Indiana	20	3.90	10,535	3.8	526
New Jersey	16	3.10	7,475	2.7	566
Missouri	12	2.33	6,473	2.35	539
Connecticut	15	2.90	6,337	2.3	420
Maryland	3	.58	3,325	1.2	1108
Iowa	14	2.70	3,221	1.17	230
Massachusetts	9	1.74	2,675	.97	297
Minnesota	8	1.55	2,018	.73	252
Texas	7	1.36	1,895	.68	271
Alabama	2	.38	1,800	.65	900
Kentucky	6	1.16	1,149	.40	191
Virginia	1	.19	1,000	.36	1,000
Tennessee	3	.58	800	.29	266
West Virginia	3	.58	765	.28	255
Delaware	3	.58	675	.24	225
New Hampshire	2	.38	552	.20	276
Washington	2	.38	500	.18	250
Georgia	2	.38	275	.10	137
Nebraska	1	.19	100	.04	100
California	3	.58	99	.04	33
Maine	1	.192	30	.02	30

MALLEABLE SAND CONTROL

David Tamor
Plant Metallurgist
American Chain & Cable Co., Inc.
York, Pa.

IT WAS SOME TWENTY-FIVE YEARS ago that, in talking to sand suppliers, the writer discussed the manufacture of a synthetic sand. As a mining engineer, he was familiar with thickeners, classifiers, settling tanks and the host of other milling equipment used in mining.

While in the northeastern section of the country we were particularly fortunate in having the molding sands of the Albany district and the sharp and bank sands of the New Jersey and New England areas, these sands in some cases offered a degree of uncertainty and variation. It was felt that if one could standardize on basic properties such as percentage of clay, grain size, grain distribution and moisture that a sand could be produced to make castings in which defects due to sand would be at a minimum.

About that time the use of colloidal clays and silica sands was being advocated by the clay producers and, in spite of the fact that the larger companies were going into synthetic sand, the smaller ones were skeptical. There was common prejudice that, although synthetic sands work well for a while, the system would get out of line in time. The sand muller was not as widely used as it is today, and the practice of such things as sand control was largely limited to large establishments or research laboratories.

Synthetic Sand

Much has been learned in twenty-five years. The general trend from the old sand pile to conveyors and hoppers has changed the picture entirely, and in the remainder of this discussion the writer will weigh the relative merits and disadvantages of synthetic sand, and its use in malleable practice.

In a mechanized malleable foundry, the usual practice is to dump the molds on a mechanical shakeout. From there the sand and core butts are transferred to a rotary screen and magnetic separator, and thence to a storage bin. From the storage the sand goes to mullers where the necessary clays, sea coal, cereal, and moisture are added, and from there to an aereator, and by means of conveyor and plows to the molders' hoppers.

With a mechanized system, it is almost necessary to use a synthetic or semisynthetic sand, and it would be well at this time to weigh the relative merits and disadvantages of a synthetic sand. Synthetic sand has a narrow tempering range, dries out easily, is brittle and difficult to repair, and requires additional equipment and control.

Against these disadvantages it must be considered that this material is more durable, as it burns out more slowly, and is easier to control. Its lower moisture content means fewer blows, good flowability, easier storage of raw silica sands, particularly in the winter season, and, above all, economy of operation. One who has never used synthetic sands will be amazed at the feel of synthetic sands and facings, and the training of personnel to handle the material will become a problem for a while.

Clay Binder Types

Many clay binders are used in a mechanized shop, and the foundryman has a choice of the fire clays, western and southern bentonite. While the fire clays have good durability, higher sintering temperatures and a wider tempering range, they have a lower permeability, need more intensive mixing and are weaker than the bentonites, requiring more clay and water for the required strength. While some use western bentonites, a good many malleable shops use the southern bentonite or a mixture of the southern and western to get a low dry strength to prevent hot tears in thin-walled work.

It must be remembered that the use of western bentonites requires intensive mixing, and sand is inclined to bake to some extent, making shakeout more difficult. It must also be borne in mind that western bentonites vary, and the particular western bentonite chosen must depend upon plant requirements. Without going too much into detail, the ionization varies in these products, as well as the ability to form sols and gels. There still is much to be learned about the chemistry of these clays and their application, and some research is being conducted along these lines.

Retaining Moisture

The drying out of the edges of a mold cavity in synthetic sand is quite a problem. Various means have been adopted by the many foundries. The use of a half pint of fuel oil to 2000 lb of sand seems to do a fair job. There is no doubt in the writer's mind that material such as glycerine and other organics can do the job. There are many inorganic chemicals that will hold moisture. Of these, particularly calcium chloride and aluminum sulfate may be corrosive on flask equipment. Here again research may unfold some fine opportunities for the mechanized foundry.

Considerable emphasis has been placed on grain size and not enough on grain distribution. It is common practice to get 75 to 80 per cent of the grains on three to four screens, and here we introduce the debatable question as to whether a sand of a more uniform grain is better than one where there is a distribution of grains. The problem of rat tailing and buckling comes into play due to sand expansion, and it would seem better to have the interstices of the larger grains filled with smaller grains to impede this shock of expansion.

To prevent undue expansion, we have resorted to various means in a mechanized foundry through the

use of silica flour, wood flour, cereal, wheat flour, and even the control of dust collecting systems so as not to remove all the fines. Advocates of a semisynthetic sand claim that the addition of naturally bonded sand to the extent of 10 per cent to the system will give a better grain distribution and prevent some of the difficulties encountered with a straight synthetic sand. Every plant should run a screen analysis to get grain distribution. Rather than plot a curve, the amounts on each screen should be put into test tubes so that the operating department can get a picture of what is happening.

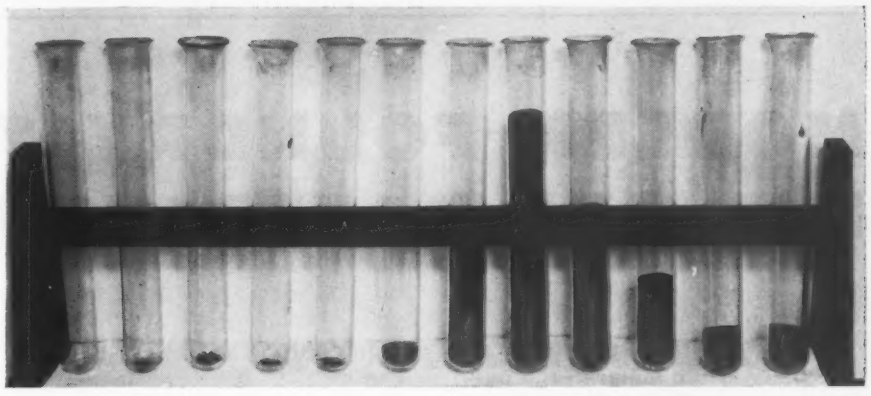
The initial use of all sand in a mechanized system is, of course, in the coreroom. The choice of core sand, its grain size and grain distribution, must be such that ultimately a compromise molding sand can be manufactured. The reason the word compromise is used is because on a conveyor line castings weighing from a few ounces to 30 lb may be poured. The raw silica sand chosen for cores will eventually become molding sand and must satisfy most of the castings going to the shakeout.

Heavy pieces and flat surfaces can be cared for with facing sand, as well as extremely light work where fine finish is a problem. In the East it is common practice to use sands of 70 to 100 in grain fineness, with 75 to 80 per cent of the grains on three screens. Simplification is the important factor, and the less complicated a system, the easier it is to maintain some semblance of uniformity and ease of operation.

Periodic Testing

Laboratory control, in view of the narrow moisture ranges involved, becomes standard practice with all mechanized units. Properties such as moisture, green compression and permeability are taken hourly. Every batch of core sand is tested for moisture. In some cases standard tensile specimens are made. Clay determinations and screen analyses are run weekly, and it is surprising how, with experience and control, the man at the sand muller can maintain the narrow limits specified.

In passing it would be well to mention the subject of hot sand. That particular nuisance develops if ample storage capacity is not provided and it is suggested that those going into mechanization get storage hoppers of sufficient capacity to eliminate the hot sand that is usual after five to six hours of operation with insufficient hopper storage. Some concerns are cooling their sand with fine sprays, and even adding binders in that manner. It is claimed that the sand is cooled only and not moistened. That, however, is not universal practice and still is in the development stages.



Rack of test tubes containing quantities of sand left on each screen after routine screen analysis.

Detroit Chapter Holds Public Speaking Course

PUBLIC SPEAKING and public relations are covered in a four-session, eight-hour course offered to the Detroit foundry industry by the Educational Committee of the A.F.A. Detroit chapter. Started January 19, the course is the first step in a program to acquaint the general public with foundries and to encourage young men to seek a career in the foundry industry.

Other phases of the program include talks before high school and trade school students, a non-technical short course for these students and, finally, a foundry visitation.

Only the foundry trade has been told that the foundry is a good place to work, while the general public has been neglected, according to Jess Toth, Secretary, Harry W. Dietert Co., Detroit, who is chairman of the Detroit Chapter Educational Committee. He feels that the foundry industry must develop some good speakers and become public relations conscious. Other members of the Educational Committee are: William N. Seese, J. S. McCormick Co.; William C. Morgan, E. F. Houghton & Co.; Robert Gardner, Ford Motor Co.; Crary Davis, Aluminum Co. of America; E. H. Stilwell, Chrysler Corp., and R. C. Harrell, Wilson Foundry & Machine Co. Mr. Morgan heads the subcommittee in charge of local participation in the 1948 A.F.A. Annual Apprentice Contest.

The classes in public speaking are limited to 35 in order to give every man a chance to get on his feet and speak at each session. Costing only $6, the course is conducted at Rackham Memorial Building by a man experienced in public relations and sales. Total enrollment is 70.

In addition to general public speaking, foundrymen completing the course are expected to be better able to handle their everyday activities, from discussing technical and operational problems to taking orders for castings over the telephone. With an understanding of the fundamentals of good public speaking and public relations, the newly trained speakers will be able to educate the community to the importance of the foundry industry.

Enroll Young Men

To bring young men into the industry, speakers will go into the high schools and trade schools where they will talk on the short foundry course to be presented by the Detroit chapter. Each speaker will be supplied with enrollment blanks and will sign up students.

The short course will be non-technical consisting of four two-hour sessions. Four speakers will address each session, talking for 20 minutes and answering questions for 10. Speakers, who will be selected for recognized ability in their respective fields, will cover the following topics: 1—selling foundry products, 2—foundry management, 3—general foundry operation, and 4—metallurgy and foundry materials.

MODERN FOUNDRY THEORY FOR THE PATTERNMAKER

E. J. McAfee
and
R. G. Wagner
Puget Sound Naval Shipyard

TWO PHASES OF SHRINKAGE take place as the metal in the mold cools to normal temperatures. The first phase results in a shrinkage in the volume of liquid metal as it solidifies. The second phase results in contraction of the casting, for which allowances are made in the dimensions of the pattern.

While the first decrease in volume is primarily a foundryman's problem, this phenomenon is also of interest to the patternmaker who is often called upon to make additional provisions on the pattern, or to build the accessory equipment required in the molding operation.

Feeding Factors

In order to compensate for volume shrinkage the foundryman holds reserve metal in readiness to add to the mold as shrinkage takes place. In some cases this may be the only precautionary measure required. In most cases, however, other arrangements must be made to supply the deficiency that occurs as the metal solidifies.

Metals differ in respect to their characteristics during solidification. Those that have comparatively low melting temperatures generally remain fluid for a period of time which may permit feeding the casting by manual methods. Others, such as steel and manganese bronzes, solidify rapidly after pouring so that manual feeding may be either inadequate or impossible of accomplishment. In order to produce sound castings under these circumstances the foundryman must have a competent knowledge of what transpires in the mold after the casting is poured.

The average patternmaker may consider this subject foreign to the realm of his craft. He often feels that his responsibilities have ended when he delivers a suitable pattern to the foundry. He may, therefore, be intolerant of a molder's demand that some change or addition be made on the pattern to accommodate the foundryman's wishes.

It must be remembered, however, that the nature of the work does not afford the foundryman opportunity to study his job until after the pattern is made. He should, therefore, expect and receive the highest degree of cooperation from the patternmaker. The production of good castings depends upon close attention and coordinated efforts of these trades, and the eminence of the patternmaker, in his field, can be found only through the results achieved by the molder in the foundry.

Patternmaker and Molder

It is evident that the qualified patternmaker is one who strives to learn and comprehend the molder's problems since his own reputation is indubitably linked with that of the molder.

It is not requisite that the patternmaker know all of the details of foundry procedure involved in the control of volume shrinkage. He should be familiar with the theories applied in modern practice and the methods used to supply the mold with reserve metal upon which the casting can draw when any deficiency occurs during solidification. This discussion, it is hoped, will provide the basic knowledge of a subject that has been much neglected in the education of the average craftsman.

Solidification Shrinkage

In the present discussion we are not concerned with the contraction of the casting that follows solidification of the metal. The primary purpose of this analysis is to show what transpires in the mold immediately after the metal is poured, and to describe briefly the processes by which the foundryman hopes to control the supply of reserve metal required to feed the casting.

This involves a discussion of gates, risers, and feed-heads, their location in respect to significant portions of the casting and the effects of atmospheric pressure in the direction and control of the feeding channels.

As a basis for consideration it will be well to analyze the conditions that prevail after the initial filling of the mold and before the metal has set sufficiently to preclude feeding processes. After the casting is poured, the metal immediately begins to lose temperature and solidification begins on the outer surfaces which are exposed to the air and to the cooling effects of the mold.

Cooling Rates

Solidification of metal is progressive and it advances from the exposed surfaces toward the center and from the lighter to the heavier masses of metal which have less surface area in proportion to their volume.

It is apparent that a flat bar will cool faster than a round bar of equal volume. A spherical body will solidify less rapidly than any other solid since it has less surface area in proportion to its volume. These facts are worthy of much consideration in the study of feeding problems.

The physical evidence of solidification shrinkage may be seen by observing the open gate or riser as the metal cools and solidification progresses (Fig. 1). As long as the surface of the metal remains fluid, there is an apparent "sucking-in" as the casting shrinks.

Such metals as lead and zinc, which have a low melting point,

Excerpts from *The Patternmaker's Manual*, published by the Training Office, Puget Sound Naval Shipyard.

may be fed by pouring additional hot metal in the gate to make up the deficiency. Metals such as gray iron, brass, aluminum, and steel generally require more extensive measures to produce sound castings. The methods employed depend upon the type of metal used and the character of the casting. Figure 1 shows these methods applied to a practical example.

The casting consists of a wire rope thimble attached to a toggle arm. The junction of the arm with the thimble results in a comparatively heavy section of metal that is difficult to feed properly through the pouring gate alone. To remedy this condition the foundryman has placed a feed-head or riser, as it is generally called, at this point on the casting. The riser extends to the surface of the mold and it fills from the casting as the metal is poured through the gate (Fig. 1A).

The theory of this method is that the riser acts as a "feed-head," which supplies reserve metal to the casting, under pressure. The pressure exerted by this column of liquid metal is in proportion to the height of the riser. Foundry experience indicates that risers with a height of 1½ times the diameter produce maximum feeding with the minimum amount of metal. Risers higher than this are wasteful and often harmful to castings. The process of feeding may in some cases be accelerated by manipulating a metal feed rod in the open riser to create a churning action in the liquid metal (Fig. 1A).

Shrinkage and Feeding

Until quite recently this was common practice in the casting industry. The prevalent theory was that this churning action, assisted by the force of gravity, released trapped air and gases from the mold, thereby avoiding the formation of cavities within the casting. Since this method was quite successful during the period that gray iron and the common brass alloys predominated in the casting industry, little progress was made toward perfecting foundry techniques in respect to shrinkage factors. The development of steel and the commercial demand for more intricate and complicated castings of newer alloys of brass and aluminum accentuated this problem for the foundryman.

Much time and study have been given to feeding methods in late years. New theories have been advanced and investigated with results that appear favorable towards the solution of this major problem. A recent development recognizes the influence of atmospheric pressure in metal casting and considers the effect of vacuum, gravity, and a preheating of the casting cavity in the mold by the passing feed metal on its way to the riser or feed-head.

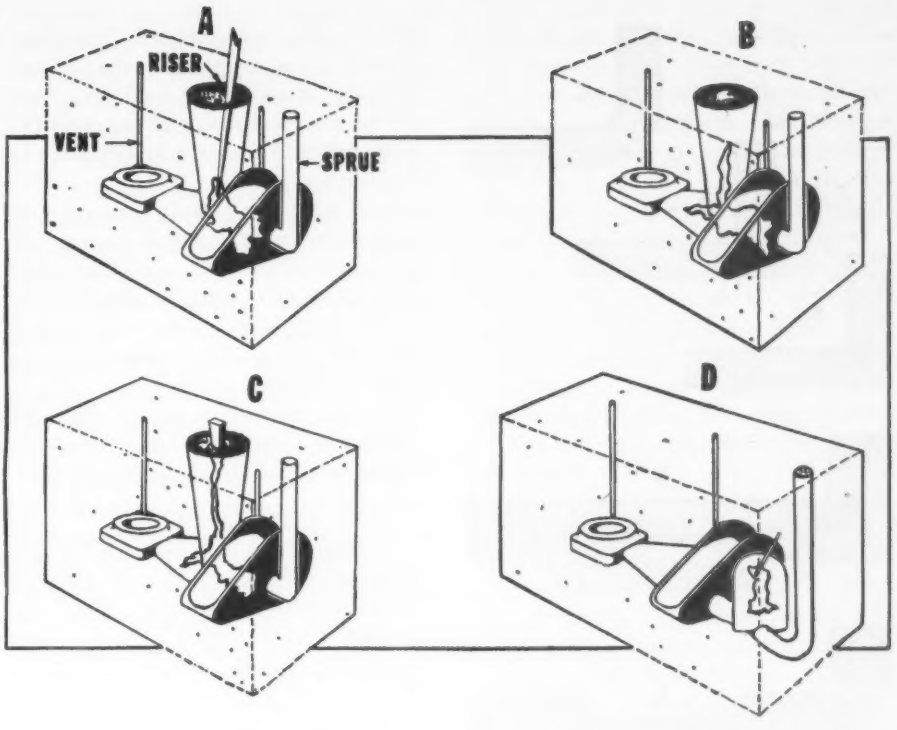


Fig. 1—Methods of casting feeding. A—Iron stirring rod in open riser. B—Void in casting as result of solidification of riser. C—Dry sand core used in riser to permit passage of air. D—Application of blind riser system.

Atmospheric Pressure

It will be remembered that, in the not too distant past, a discussion relating to atmospheric pressure in the foundry or pattern shop was largely limited to the ventilating system. Yet the molder, unknowingly, utilized this potent force when he kept the riser open by the churning or prodding method.

Many years elapsed before the theory was expounded that atmospheric pressure, and not the churning manipulation of the feed rod, was the effective force that conveyed the metal to its destination. It is now conceded that the feed rod did little more than keep the channel open so that atmospheric pressure thereby remained effective on the fluid surface of the metal.

Atmospheric pressure exerts a force of about 14 psi at sea level. A manifestation of this power can be exhibited by breaking an ordinary electric light globe. The glass shell of the globe encased a vacuum. Webster says a vacuum is "a space entirely devoid of matter." Since the air is withdrawn from a light globe in the process of manufacture, it may be said to contain a void or vacuum.

It has been said that "nature abhors a vacuum," hence it exerts a pressure of 14 psi against the surface of the globe in an effort to fill the vacuum within. If the shell excluding the atmosphere is broken, the air rushes in to fill the space with an explosive force sufficient to splinter and scatter the glass over a wide area. Another convincing demonstration of atmospheric pressure can be made by submerging a part of a light globe in water and boring a small hole in the submerged surface. Although the air is excluded from entrance by the surrounding liquid; atmospheric pressure pushing against the surface of the water will force it to fill the vacuum high above the normal water level.

With these facts in mind, it is but a short step to supply the theory of atmospheric pressure to metal casting problems. Consider the toggle thimble (Fig. 1) which has been used to illustrate the feed-head. After the initial filling of the mold, solidification progresses, the walls

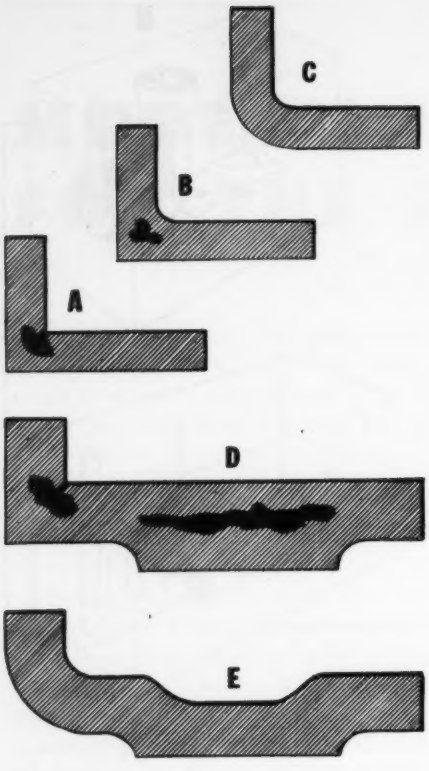


Fig. 2—Effects of unequal shrinkage due to increased sectional thicknesses at junction of casting members. A—Shrink cavity in sharp corner due to delayed solidification. B—Added fillet partially corrects condition shown in A. C—Filleted and rounded corners promote uniform solidification. D—Heavy section adjacent to thin section. E—Excess metal has been removed and the adjacent corner rounded.

thicken until they are strong enough to resist air pressure which is present on all surfaces of the casting because molding sand is sufficiently permeable to permit entrance to all points.

As volume shrinkage follows solidification, it is apparent that a deficiency would occur in the metal remaining liquid in the interior of the casting. Two things can transpire as shrinkage continues and metal is drawn from the hot spots in the mold.

Figure 1B shows how this affected a casting which had not been fed by manual means. First, a void was formed in the fluid portion of the casting. Collapse of the riser walls followed as the air tried to gain entrance to the vacuum.

The cylindrical shape of the riser explains the point of this collapse. Since there is less heat-dispersing surface in this area, the walls have solidified only sufficiently to partially resist atmospheric pressure. Thus it is apparent that some method must be devised to admit air to the riser and thereby prevent the formation of a void within the casting proper.

As was previously stated, all metals do not respond to manual feeding. Steel has quick-freezing characteristics which would preclude the use of a feed rod to keep the riser open. The great degree of contraction in steel, about 3 per cent in volume, increases the difficulties of keeping the feed channels open to atmospheric pressure.

Dry Sand Core

Figure 1C shows a method devised to allow entrance of the air through means of a dry sand core. The core is made wedge shaped and especially permeable to allow ready passage of the air. As soon as the casting has been poured, the molder inserts the core in the riser and it is held there until surface solidification locks it in position. The tapered point heats rapidly from contact with the liquid metal. This tends to prevent the formation of a metal envelope around the core, which would otherwise obstruct the air channels.

The method just described has been used with good results in cases where the feed-head extends to the surface of the mold. The open riser is favored by many foundrymen because it has some advantages that are not attributed to other methods which will be discussed later.

Experience has shown that the better metal is usually found in the lower portions of a casting. It is believed that gravity exerts a compressive force which tends to a closer grained metal structure. The fact is cited in favor of a feed-head elevated above the casting proper.

Another advantage is that any impurities such as particles of sand, dross, gases and trapped air tend to rise and are therefore conveyed to the riser. Hot metal may also be poured into the open riser after the casting level has been reached, thereby assuring the presence of the last poured and hottest metal in the feed reservoir.

Special Blind Riser System

Many experiments have been conducted to find means of feeding heavy and isolated sections of castings which are inaccessible to open riser methods. Heavy sections are often so widely distributed over the casting structure that all of them cannot be reached from the cope.

Since the heavy masses of metal remain fluid for a longer period, it is natural that those portions having early solidification will feed on the heavy portions. Some means must therefore be arranged to provide reserve metal so that these portions may be fed in turn. In order to distribute these reservoirs of feed metal as needed, they may be entirely confined within the mold body.

These so-called blind risers have been used in foundry practice for many years, sometimes with quite dubious results because their location, lower in the mold, naturally reduces their gravity head and because solidification of the riser surfaces, in contact with the mold, closed off atmospheric pressure.

The results of this were often contrary to what was desired. The riser would in some cases feed from the casting. Thus it is seen that "directional feeding" is a factor for consideration in this problem.

Blind Risers

A system of blind risering castings has recently been perfected and patented. The author will attempt to disclose the essential features of this system, avoiding the technical aspects as much as is consistent with the purpose of this article. The features of this system have had wide publicity in trade and technical magazines, generally from a highly technical point of view.

The essential factors pertaining to this subject have been discussed in the foregoing analysis. In the consideration of this system, the value of directional feeding and atmospheric pressure is stressed and a unique method of control has been developed to a high degree.

There is a growing tendency toward engineering these problems in the pattern shop, thereby avoiding the delay and expense of making alterations to the pattern and foundry equipment after the pattern has been completed and mounted for use as conditions may dictate. Since each casting presents an individual problem which prohibits laying down hard and fast rules, it is essential that the patternmaker learn the fundamental principles that apply to modern practices.

Figure 1D shows the application of the blind risering system to the

project under consideration. This method does not prohibit the use of the ordinary open riser. Both methods may be used concurrently when, in the opinion of the foundryman, it is desirable to do so. However, in the present case, the patented system proved its efficiency to a degree that entirely obviated the use of an open riser.

The distinctive features of this newer system may be enumerated as follows: 1. The spherical nature of the riser conserves the heat elements since surface area is reduced to a minimum. 2. The riser is located on the gate and ahead of the casting. The riser is therefore preheated by the first poured metal on its journey to the casting cavity. Hence the preheated riser cavity becomes the reservoir of the last poured and hottest metal, which is as it should be to avoid early solidification of the feed metal. 3. Atmospheric pressure is given access to the riser cavity through two methods—small-diameter cores or a graphite rod which is embedded in the head of the riser. Both of these methods allow the atmospheric pressure to enter and act on the last molten metal in the riser, thereby compelling flow to the casting.

Riser System Theory

Much more time could be profitably expended in the study of the principle supporting the theory upon which this riser system is based. However, the present discussion will be confined to those features that have practical value to the craftsman in his daily work.

The patternmaker is primarily interested in the methods of procedure and the reasons for applying them to the job. In this respect it will prove enlightening to survey the advantages claimed for this system. These are numerous and well worthy of consideration.

The following digest will enumerate the advantages and then give the reasons in support of the theory upon which it is based.

1. Controlled or directional feeding is accomplished by admitting atmospheric pressure to the riser through a permeable core.

Theory—Atmospheric pressure is present on all mold surfaces since molding sand is permeable in nature. This pressure is effective until solidification closes it off, excluding the air from the casting interior. If access is provided at a fixed point, this force will tend to drive the liquid metal away from the opening to such sections as may accommodate the surplus.

2. Solidification is retarded in the riser so that it may function as a reservoir of fluid metal until volume shrinkage has ceased in the casting structure.

Theory—The first poured metal cools as it passes through the riser and over the mold surfaces. This encourages early solidification of the metal deposited in the casting cavity of the mold. Therefore, the hottest metal remains in the riser cavity where solidification is retarded; first because of the limited surface area of the riser as compared to its volume; second, because this surface area has been preheated by the passage of the first poured metal.

3. The blind riser may be located near such areas as may require reserve metal to produce soundness.

Theory—When casting members are joined by uneven sections, it may be necessary to supply additional liquid metal to several sections of the casting. If these sections are distributed so that some are in the lower or remote portions of the mold, it may be impractical or impossible to use an open riser. As the thin sections, which have early solidification, draw feed metal from adjacent heavy sections, the deficiency increased by volume shrinkage of these members may create a serious feeding problem. Since the blind riser is entirely enclosed in the mold and the loss of gravity head is compensated for by atmospheric pressure, they can be used to advantage under these conditions.

4. Smaller risers are practical by this system.

Theory—The close proximity of the blind riser to the shrinkage area reduces the dissipation of heat through surface contact. This permits the use of smaller risers with a consequent higher production at reduced melting costs.

5. Cleaning costs are reduced.

Theory — The elimination of heavy risers with a wide contact area and the ease with which blind risers can be located on suitable surfaces reduce cutting, chipping, and grinding costs to a minimum.

6. Bottom gating is entirely practical with blind risers.

Theory—There are many cases where is is desirable to gate the casting from the bottom. Abrupt shrinkages or secondary contraction of thin sections promotes the tendency to hot tears at their junctions with heavier sections. When contraction can be retarded until these sections have solidified, there may be uniform contraction of the whole casting structure. The danger of tears or ruptures is greatest when the metal is in a plastic state just prior to solidification. Since heat radiates vertically, it is indicated that bottom risers will tend to heat the mold, thereby retarding secondary contraction until this danger zone is passed.

Design Factors in Foundry Production

The influence of casting designs on production phases in the foundry are frequently neglected until difficulties are encountered which cannot be remedied in the molding processes. A number of design factors control quality dependability in castings. The best designed castings are those which have uniform sections or progressively increase in thickness to a central location where a riser can be placed. Abrupt changes in sections are to be avoided and sharp corners are not desirable.

Shrinkage characteristics of some metals make it mandatory that attention be given to these details if structurally sound castings are to be produced. This applies with particular emphasis to steel and certain non-ferrous alloys which have rapid solidification tendencies. Unequal solidification sets up internal strains, causing shrinkage cavities and cracks which would not be evident in slower-setting metals.

Sometimes the specifications of a casting are amended without compensating alterations in the plan. In such cases, a basic design may be violated unless the error is found in the pattern shop or foundry. The patternmaker is in a favorable position to observe the metal distribution in the casting structure. Progressive designers encourage initiative and give the patternmaker wide latitude in suggesting changes that will simplify the molding processes or improve the structural integrity of the finished product.

Experiments have demonstrated that sharp inside corners are poor designs regardless of the kind of metal used in casting. In steel, this condition is exaggerated because the microscopic grains of which the

metal is composed grow normally to the faces forming the corner. Hence, the junctions of the crystals constitute a potential source of weakness which cannot be remedied.

Figure 2 shows the effects of unequal shrinkage due to increased sectional thickness at the junction of casting members. Figure 2A shows how a shrink cavity is likely to develop in a sharp corner, owing to delayed solidification at that point. This defect will generally appear as a crack on the surface and extend, as a cavity, to the interior of the casting. It is obvious that this would cause a rejected casting, even though it appeared where strength was not essential.

Figure 2B shows how this condition can be alleviated so far as appearances are concerned. Although the interior defect remains in an aggravated form due to the increased sectional thickness caused by added fillet, good serviceability may be obtained by this method, when design limitations do not permit further modifications, because the strength of the member has been enhanced considerably.

Uniform Solidification

However, this is a hazardous condition both from the aspect of serviceability and the standpoint of foundry production because there is danger of tearing or cracking at this point in metals which have high solidification shrinkage. Whenever it is possible, all corners should be well filleted and rounded, as shown in Fig. 2C. The interrelationship of the metal crystals is thereby improved and uniform sections promote even solidification.

Figure 2D shows another design that is to be avoided. Here a comparatively heavy section is formed adjacent to thin sections due to the presence of a thick pad. In cases of this kind, it may be permissible to lighten the section by relieving the underside of excess metal.

An attempt has been made to eliminate the objectionable features of the foregoing design by rounding the adjacent corner and removing excess metal from the under side of the pad (Fig. 2E). This is a step in the right direction, and it brings another factor to attention. Resistance to the flow of metal should be reduced to a minimum. This may be accomplished by streamlining all contours as much as possible.

COST CONVENTION PROGRAM TO BE BUILT ON QUESTIONS

ONE OF THE greatest problems confronting the entire foundry industry today is cost. A great deal has been said about the subject but the A.F.A. Foundry Cost Committee is giving everyone in the castings field an opportunity to do something about it. The committee is urging all members to cooperate in sending questions concerning costs to the National Office immediately.

The A.F.A. Foundry Cost Committee intends to develop its 1948 convention sessions from the questions that will be submitted by February 25. The success of this program largely depends upon the general participation of all branches of the foundry field. The sources of all material will be treated in a confidential manner, with original question and answers to be mimeographed and made available at the convention cost session.

The committee is asking those who submit questions to restrict themselves to:

(1) Cost problems of general interest, but specific in nature and clearly defined.

(2) Methods of cost accounting, distribution of costs and application of information derived from cost accounts.

In undertaking this unusual approach to the development of a national convention program, the Cost Committee is prepared to shoulder the added burden that will be incurred through working out recommended procedures which will comprise the answers to questions submitted to the committee comprised of: Ralph L. Lee, *Chairman,* Grede Foundries, Milwaukee; George Tisdale, *Secretary,* Zenith Foundry Co., Milwaukee; C. R. Culling, Carondelet Foundry Co., St. Louis; A. W. Plier, R. J. Murray Mfg. Co., Wausau, Wis.; C. S. Roberts, Dodge Steel Co., Philadelphia; N. J. Schmidt, Gunite Foundries Corp., Rockford, Ill.; and C. E. Westover, Westover Engineers, Milwaukee.

The A.F.A. Foundry Cost Committtee has long held to the conviction that profitable foundry operation, like the conduct of any successful big business, is contingent upon satisfactory analysis for all plant operations. Consequently, A.F.A., through the cooperative efforts of the Foundry Cost Committee, continues to make available simple cost accounting methods in forms readily adaptable to the smallest foundry.

Foundry Organizations Form Castings Council

NATIONAL CASTINGS Council has been formally organized with the following founding members: American Foundrymen's Association, Foundry Equipment Manufacturers Association, Foundry Supply Manufacturers Association, Gray Iron Founders' Society, Malleable Founders' Society, National Founders Association, Non-Ferrous Founders' Society Inc., and Steel Founders' Society of America.

The Council has been organized to provide a medium for co-operative action among its members on matters of mutual interest beyond the scope of the individual societies or in connection with problems which can be handled better by co-operative action.

The Council has elected the following officers: *President,* Howard A. Stockwell, secretary, Barbour Stockwell Co., Cambridge, Mass., and president, Gray Iron Founders' Society; *Vice-President,* Otto A. Pfaff, president, American Wheelabrator & Equipment Corp., Mishawaka, Ind., and president, Foundry Equipment Manufacturers Association; *Treasurer,* F. Ray Fleig, president, Smith Facing & Supply Co., Cleveland, and president, Foundry Supply Manufacturers Association; *Secretary,* F. G. Steinebach, Penton Publishing Co., Cleveland.

The recent formal organizational meeting was devoted to a discussion of the organization of the Council, and to further action in connection with the by-laws of the organization. The representatives on the Council also discussed problems connected with safety codes, the idea of establishing a clearing house for convention and meeting dates of organizations in the industry; and contact with the Munitions Board.

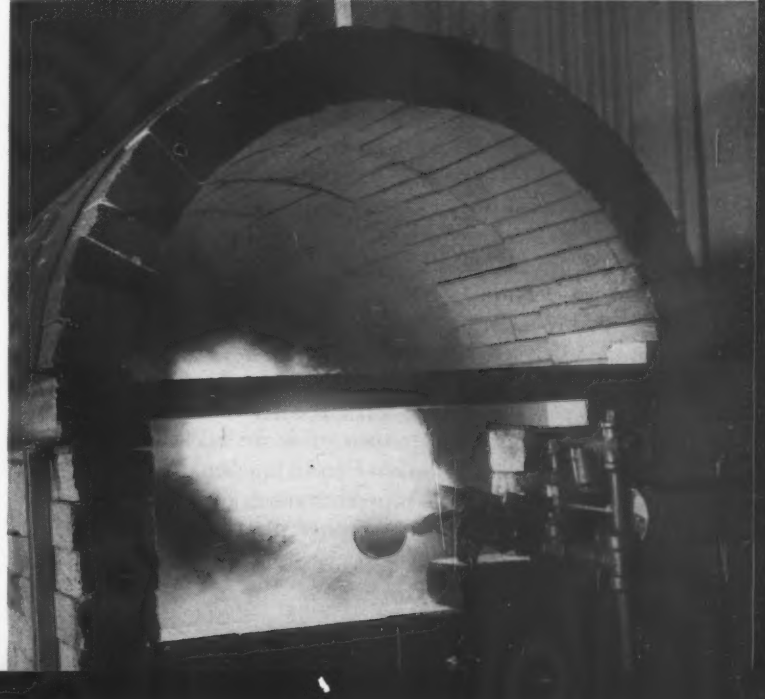
New Research Laboratory Opened By Air Reduction in New Jersey

NEW USES for the industrial gases in the production and finishing of steel products are among the research activities being conducted by Air Reduction Company at its new apparatus research laboratory, Murray Hill, N.J. The "lab" was placed on display at the company's "open house" when it was opened for inspection, and demonstrations of certain processes were given (see illustrations).

The new laboratory was completed last spring, but full-scale operation was not realized until recently when the building became fully staffed and all necessary equipment had been installed. Some 250 engineers, metallurgists, physicists, chemists, technicians and machinists are now engaged in research in this laboratory.

The main building is a red brick structure and provides 78,000 sq. ft. of floor space; there are also two service buildings. In addition to the main high ceilinged machine shop and test and assembly area where special experimental machinery and apparatus, and prototypes of production equipment are made, there is another high ceilinged, especially ventilated flameproof area for conducting experiments in the combustion of gases and processing of metals. There are, also, a number of conventional service laboratories, such as an x-ray room, chemical laboratory, mechanical testing laboratory and metallographic laboratory.

One of the newest, and perhaps the most important, of the industrial gas applications on which the company's researchers are busily at work involves the use of oxygen as an aid in the combustion of fuel in melting operations and the control of hot metal analysis. Test work already conducted in the open hearth indicates that the relatively long period involved in melting down steel scrap may be shortened as much as 40 per cent, but final figures are not available until further experimental work has been completed.



Top—Aerial view of new apparatus research laboratory. Center—Scarfing steel surface by use of oxyacetylene flame. Bottom—Test of oxy-generated fuel flame.

The use of industrial gases for refining metals has advanced rapidly in the past two years. Initial experiments in this field have been made in the steel industry where oxygen is injected into the molten bath of the open hearth to bring about rapid carbon reduction. This results in higher steel production.

Surface imperfections which develop in the casting of steel must be removed in order to obtain a quality product. In the case of ordinary steels, this has been done by scarfing, a process which consists of removing a thin layer from the surface of the metal through the use of oxyacetylene flame. This process is now applicable to stainless steels.

Less spectacular, but of equal importance to the industries involved, has been the development of inert gas applications, using nitrogen or hydrogen as a base, for the protection of metals during heat treating. In the manufacture of high silicon transformer steels for the electrical industry and in the making of high grade alloy steels for the automotive industry, protective atmospheres are playing an increasing role in improving product quality.

View of foundry after "color conditioning." The colors used were: roof trusses, aluminum; ceiling, white; sidewalls, high reflection green; dado, medium green; switch boxes, precaution blue; fire apparatus, fire protection red, and trim, medium green.

Engineering Division
E. I. du Pont de Nemours & Co.
Wilmington, Del.

Paint an Old Foundry?

COLOR CONDITIONING PAYS OFF

IN THE FACE OF CONSIDERABLE SKEPTICISM the Brillion Iron Works, Inc., at Brillion, Wisc., decided to adopt a "color conditioning" program for its foundry. The plant superintendent, C. W. Schwenn, insisted that the program should not be confined to merely a random paint job, and it was arranged that the work be done along the functional lines of a color conditioning system worked out by the paint manufacturer's engineers. To complement the program, improved lighting was provided and a thorough and permanent clean-up campaign instituted.

Today the foundry management—like many other industrialists—feels that the program has been amply justified, as it has contributed its part toward bettering the working conditions of the employees, with a resultant improvement in morale and production.

One of the greatest problems facing management today is labor relations. Since the wage earner spends the greater portion of his waking hours in the plant, it is logical to assume that he is interested in a satisfactory environment while at work. If his place of employment is not attractive, it is only natural that the worker indulge in the human propensity to look on the other side of the fence, hoping that the grass will be greener in other fields or in competitive shops.

This fact was fully appreciated by the foundry management, and it was decided to provide the employees with a better plant in which to work. A look at the record will show what was done, and what it has meant.

Painting Considered Functional

"Color conditioning" might be compared with air conditioning in what it accomplishes. Each contributes something to the workers' efficiency, health, comfort and morale. The scientific system for using color is essentially concerned with results—not with mere appearance. Interior decoration is set aside for the more practical effort of making painting functional.

Several years ago, representatives of the paint manufacturer were asked to prepare plans and specifications for painting the foundry and coreroom at Brillion. One reason for this invitation was that previously the company's machine shop had been reconditioned according to functional color specifications. Evidently the management felt that, from the results of the earlier installation, a similar program might prove effective in the foundry.

The paint experts tackled the foundry, and found that their problem was a tough one. It is comparatively easy and simple to make specifications for a new job, where the area has never been subjected to smoke, gas, fumes and other paint-discoloring abuses. In this foundry conditions were much more difficult. The plant had been used for years; ceilings, trusses, walls and equipment were badly stained and discolored, and the steel was in a far from satisfactory condition.

Preparing Surfaces

Here, step by step, is what was done: The steel was scraped free of rust and properly primed, and all other surfaces cleaned so that all traces of dust, dirt and other foreign materials were eliminated. Then came the paint job. The ceiling was painted white; the sidewalls a high-reflection green, with a dado of medium green. Machinery and equipment were painted in a medium tool gray. All equipment was "coded" in Safety Color Code colors.

The choice of green for the walls was made because it is a practical, unobtrusive color. The particular shades of green used are slightly grayed to minimize dust collection, and tests have shown that under most conditions it is the best color for workshops. Green shades, being cool, restful, free from glare, and lacking in monotony, are therefore particularly suitable for interiors occupied for many hours a day. Since the brightness of the wall color is such that glare is minimized, it relieves eye strain and is a tangible aid to good production.

The paint job was complemented with the installation of modern lighting facilities. Mercury vapor lamps

were installed in both the foundry and the coreroom, giving a maintained foot-candle reading of 35 in the foundry and 45 in the coreroom. Proper lighting has not only made the plant a better place in which to work, but has enabled the men to turn out higher quality products and increase production.

Once the remodeling was completed, vigorous steps were taken to keep the plant in immaculate condition. In the words of the superintendent:

"We inaugurated a good housekeeping program. This was not a short clean-up campaign, but a continuous program whereby the entire plant was cleaned and painted, and steps were taken to insure its being kept in that condition. . . . We have a large vacuum cleaner for use on the walls and ceiling, as well as on the floors in some departments. We find that periodical cleaning of walls and ceiling in each department will eliminate the necessity of frequent painting. Dust accumulates, to be sure, but it is removed rather easily if not allowed to remain too long." This seems to be the best formula for maintenance the writer has heard.

Project Integrated

Brillion's "color conditioning" program started three years ago as a pilot plant job. The war was still going on, and paints were scarce. Even now they are not available in desired quantities. But in planning the work at Brillion, the whole project was integrated, embracing numerous units in different operating areas of the plant. At all times the entire picture was kept in mind. Many other factors besides painting naturally entered into the program. An estimate of the results of this three-year program was made by the plant superintendent and summarized as follows:

1. The program has been the greatest contributing factor toward an excellent relationship between labor and management.
2. It has helped maintain an exceptionally high level of employment through the war period and in this immediate postwar period.
3. Daily tonnage has increased from a 40-ton average to 72 tons.
4. A substantial reduction in scrap percentage and machine shop rejects.
5. A reduction of approximately 8 man-hours per ton of good castings.
6. Customer good will has been improved, not only by a high quality product delivered on time but through confidence in the foundry organization inspired by plant visitations.

Foundry management was quick to appreciate the gains effected by providing employees with a better plant in which to work, and the customers received a fine impression of the plant which did the work for them. Proof that the painting of a foundry was a success is the fact that the management repeated "color conditioning" as a summer painting program for 1947. The interiors are again clean, and the foundry has the appearance of a new plant.

When the "color conditioning" program was drawn up it was scientifically developed to promote efficiency, increase production, improve quality and reduce personal injuries. The experts were concerned with getting results—not merely improving appearances. The results are evidence of the value of painting rugged areas which are generally overlooked.

A. F. A. Announces Five-Point Plan To Bring New Blood Into Foundry

A FIVE-POINT PLAN for bringing new blood into the foundry industry has been announced by the American Foundrymen's Association. Outlined in a six page folder mailed to foundry management in the United States, Canada, and Mexico, the plan calls for executive action in meeting foundry personnel needs.

The plan, developed by the A. F. A. Educational Division, is based on personal contact with students. Briefed, the five-point program follows.

Selection—Select schools to contact after determining plant personnel needs.

Contact With School Officials—Top foundry management should approach the principal or dean—top school management—and explain the company's personnel problem. Emphasis should be placed on the number and type of foundry jobs available.

Plant Visitations—In cooperation with the faculty, schedule plant visitations for students most interested in the foundry and for their teachers. Suggestions for plant visitations are contained in an A.F.A. pamphlet, PLANNED FOUNDRY TOURS.

Student Interviews—The final step in securing new blood for your plant is the interview with the student. These can be arranged through the faculty and should be held soon after plant visitations and well in advance of graduation.

Personnel Investment—After your company's personnel needs are filled, train the new men. Every company's most valuable investment is the men in the business.

Listing the A. F. A. chapters and members of the Educational Division, the folder suggests counselling with them and with A. F. A. headquarters regarding the five-point plan and all foundry educational problems. Copies of the A. F. A. five-point plan for bringing new blood into the industry can be obtained from the American Foundrymen's Association, 222 W. Adams St., Chicago 6, Illinois.

PRESSURE FEEDING OF STEEL CASTINGS

W. T. W. Shute
Canadian Car & Foundry Co., Ltd.
Montreal, Canada

THE EXPRESSION "pressure feeding of steel castings" has been applied to a variety of methods and, in fact, all feeding is by pressure. Ordinary static gravity feed creates a pressure of about one psi for every 4 in. under the top level of liquid metal. For most castings, this pressure will therefore rarely exceed 2 or 3 psi at the opening into the casting at bottom of riser.

Usually this pressure is greatly increased by atmospheric pressure, which, in the case of blind risers, is applied by means of the patented Williams method. The outside air is allowed to enter the riser, relieving the partial vacuum of the shrinkage cavity. The effective atmospheric pressure is something less than 14½ psi and, by applying it to the risers only, the metal is forced from riser to casting during solidification.

This pressure has been found sufficient to feed upward against gravity, with safety, for a distance of 18 in. Then, by centrifuging, high peripheral pressures approaching 1,000 psi have been reached, although at the opening nearer the center of rotation this pressure probably never exceeds 100 psi in practice.

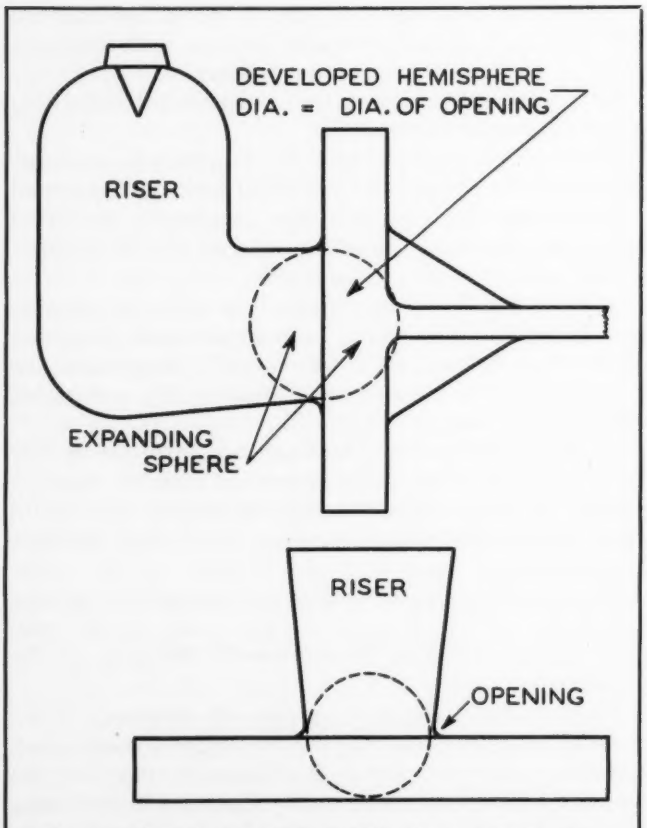


Fig. 1—Sketch showing application of Rule 1 to determine size of riser opening.

A new departure has been the remarkable method used by S. T. Jazwinski and S. L. Finch in England. By creating pressure synthetically within risers, almost any desired pressure can be applied on any casting. Apparently, the best experimental results have been had with pressure calculated at about 350 psi. The pressure is released from an exothermic, gas-evolving compound.

A pellet of this compound is suspended by a wire inside the riser, and it starts to work soon after a skin solidifies around the riser, which automatically creates a pressure chamber. Once control difficulties have been overcome, this method has promising possibilities.

In applying all of these methods, the question arises—just what is to be gained from them? The properties of the metal apparently are unaltered. The necessity of feeding the casting still remains, and the risers must be the last parts to solidify. So why not be satisfied with a low pressure?

The first and most obvious answer is that high pressure allows the pouring of intricate and thin bodies which otherwise would be impossible in steel. It also produces sharper outlines and closer tolerances. These advantages apply chiefly to centrifuging.

Solidification Principles

There are other answers, however, which apply to all methods, and which can be clarified only by first examining the simple and fundamental principles of directional solidification, and the regular rules of heading and gating. These rules vary from man to man, and from shop to shop. In the writer's opinon, the most reliable set of rules is the following:

Rule 1—In Fig. 1 an imaginary hemisphere is plotted inside the casting, so that its flat surface will form the opening for the riser. Then, when the riser is added, the complete sphere is the largest which will fit into the mold at this point. The sphere is unmovable except in the direction of the riser. This is simply a geometrical method of laying out risers and openings so that completion of solidification will follow an uninterrupted path from the extremities of the casting to the final phase inside the riser.

In order to obtain perfect directional solidification (ignoring chills for the time being), a contained sphere within the mold at any part—if it is allowed to expand

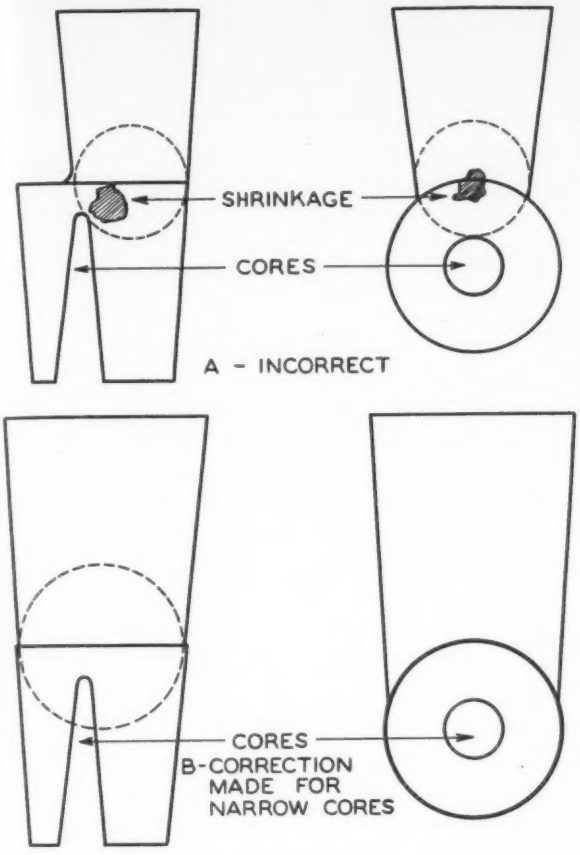


Fig. 2—Sketch of unusual structure illustrating the exceptions to Rule 1.

freely but not to contract—ought to be movable only in a direction which leads to a riser. This principle of the "expanding sphere" is based on the assumption that the speed of skin formation on all surfaces is the same. This, of course, is not always true, even approximately. However, the principle is a good starting point, and dangerous exceptions can always be perceived in advance. Furthermore, it works in practice.

Exceptions are confined to unusual structures, in practice, such as those sketched in Fig. 2. Any narrow core or cavity projecting into a casting will restrict the size of the sphere. A similar situation exists with a small core in a cylinder. If the rule is followed strictly, as in Fig 2 (A), the casting will contain shrinkage.

Since solidification is quite slow around these narrow cores, it is best to ignore them almost entirely when calculating the hemisphere, as is done in Fig. 2 (B), the proper solution. Likewise, some minor deviations from the rule can be made when allowing for medium-sized cores, chilling, necked-down risers, temperature gradient, and even the total mass of the casting.

Rule 2—After fixing the size of opening and riser, there is a rule to govern the number of risers. Quite often this is determined by the number of "hot spots" which must be fed. However, in a large casting of even metal thickness, to ensure sound metal throughout, this question is not so simply determined. A riser will feed just so far through an even section before shrinkage occurs and wall collapse takes place in the casting.

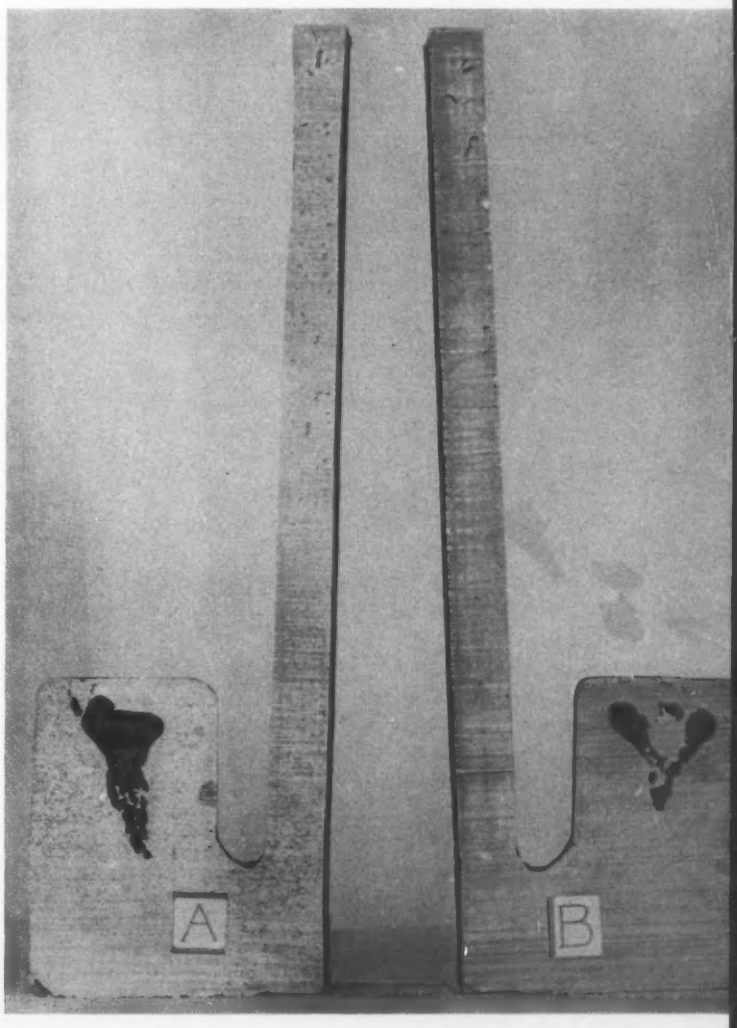
A rule which is followed by many foundrymen gives very satisfactory results. The rule states that in an even wall, the interval between risers should not be more than one foot for every inch of metal thickness. For example, in a large drum, with the feeding at a wall of even 4-in. thickness, the risers should not be more than 4 ft apart. This rule has no proof except the proof of experience in practice. The distance between risers may be extended somewhat with chilling.

There are many instances where these two rules cannot or need not be followed to the last degree, and there is more to them than what has been briefly stated here; but there they are, and they give a starting point.

Now, where does pressure fit into the picture? If a certain size of riser is needed on a job, or a certain number of risers, what can be gained in quality, yield, or cleaning costs, by applying extra pressure? In the first place, pressure changes *Rule 1*. The application of pressure by itself is known to have a beneficial effect on feeding. The use of atmospheric pressure, or atmospheric pressure plus gravity, ordinarily reduces minimum feeding requirements slightly below those called for in *Rule 1*.

With atmospheric pressure, the rule contains a factor of safety well above the minimum riser and opening needs in most cases. With the higher pressures of cen-

Fig. 3—Sections of two 30-inch, vertical slabs. A—Cast without atmospheric pressure in riser. B—cast with atmospheric pressure in riser (Williams method).



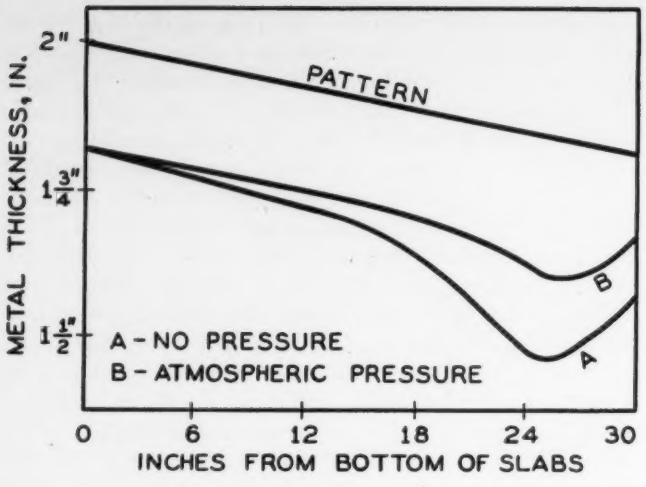


Fig. 4—Graph showing extent of wall collapse of 2x4x30-in. vertical slabs (see Fig. 3).

trifuging, many examples have proven that castings can be fed solid through much narrower openings. The experiments of Jazwinski and Finch have shown that the same advantage can be had with their synthetic pressure heads. These facts alter *Rule 1* and show that another factor, pressure, must be taken into the calculations. What proportion this factor assumes depends on the amount of pressure, and the problem still remains in the field of trial and error. The formula—Diameter of Opening = Diameter of Hemisphere × some function of Pressure—remains to be solved.

In other words, the practice of high pressure feeding permits the use of smaller openings and risers; but the only known method of determining how much smaller is to try out different sizes on any one job. This advantage of higher metal yield probably depends to a large extent on obtaining a favorable temperature gradient, either by gating or using exothermic compounds.

Second, the use of higher pressures permits the use of fewer risers, and so *Rule 2* is also altered. Here again, the foundryman is still in the dark, and awaiting results from research specialists. Production men know that it is true, but they do not know the limits. The high yields gained by centrifuging depend on high pressure, which permits the use of one riser where several would otherwise be necessary.

A few general items are of interest when dealing with pressures. In feeding by gravity, the pressure increases in departing from the riser in a downward direction. In using atmospheric or synthetic pressure to feed upward, the effective pressure diminishes as the distance from the riser increases.

In centrifuging, the effective pressure increases the greater the distance from the center of rotation, and the higher the speed. Also, in most cases, gravity heads have, or ought to have, atmospheric pressure, and the effective pressure is the total of the two. In centrifuging, advantage may be taken of all three types of pressure. Although the different methods of applying pressure are discussed separately, it must be remembered that they are often combined, with effects additive.

As a method of determining the effective range of atmospheric pressure, two 30-in. vertical slabs were cast at this plant, with oversize risers at the bottom supplying the feed. Figure 3 is a photograph of these slabs sectioned down the center. Slab *A* was cast without permitting atmospheric pressure to enter the riser. Slab *B* was cast with atmospheric pressure by the Williams method. Both castings were gated into the riser, independently, and scattered shrinkage is shown above a height of 14 in. in Slab *A*, and above 20 in. in slab *B*.

In addition to the shrinkage, the walls of the slabs collapsed or caved in at certain heights, where the internal pressure was no longer effective against the air pressure outside the casting. The higher the point in the riser at which pressure is applied, the less effective the pressure becomes. The extent of the wall collapse is shown on an exaggerated scale as plotted in Fig. 4. The vertical distance between the pattern line, and the lines *A* and *B*, represents normal shrinkage and contraction. The curvature of lines *A* and *B* represents wall collapse due to insufficient pressure.

This experiment demonstrated the limits of using atmospheric pressure in blind risers. Further experiments are contemplated, using this method, to determine the limits of other pressure methods. The method of experiment is suggested as a means of discovering the effects of high-pressure risers, as affecting *Rules 1* and *2;* and also as a standard for comparing pressures in different types of pressure feeding.

The possibilities of pressure feeding are largely unknown, and the outcome of current experiments is being awaited with great interest. This is especially true of the more recent trials with exothermic and gas-evolving compounds. This system lends itself to all types of work, large and small, while the application of centrifugal force is limited to certain shapes and sizes.

References

S. T. Jazwinski and S. L. Finch, "A New Method of Feeding Applied to Castings in Static Moulds," Foundry Trade Journal, Nov. 29, 1945, p. 269.

H. F. Taylor and E. A. Rominski, "Atmospheric Pressure and the Steel Casting," TRANSACTIONS, American Foundrymens Association, vol. 50, p. 215 (1942).

DO YOU HAVE PROBLEMS?

You can help yourself and the foundry industry by outlining your foundry research problems for the College Research Projects Committee of the Educational Division.

This committee is stimulating foundry research in engineering schools by preparing and distributing a booklet outlining foundry research problems. This work is entirely separate from research carried on under division research committees and A.F.A. sponsorship is not contemplated.

Prepare your suggestions for one or more research projects according to the outline: discussion; value of project; suggested procedures; and facilities needed.

Send your college research project suggestions to Prof. Richard Schneidewind, Chairman, A.F.A. College Research Projects Committee, Dept. of Chemical and Metallurgical Engineering, University of Michigan, Ann Arbor.

MANAGEMENT'S STAKE IN PERSONNEL TRAINING

Ralph L. Lee
General Motors Corp.
Detroit

FOR THE PAST TWENTY YEARS now, and through no particular ambition on my part, it has fallen to my lot to help plan and take part in various personnel training activities, both in sales and industry. As I look back over this period of widely varying experiences and results, I find one thing common to practically every program I have had anything to do with—management's belief that personnel training and education was unquestionably, a good thing, a needed activity and frequently, in a vague sort of way, a profitable activity.

Underlying this belief of management there seemed to be the conviction that if the rank and file knew what to do and how to do it they were bound to do the right thing. Therefore on this basis, the more anyone knew about his work the more and better work he would do. I must admit that at times I have had reasons to doubt this, as demonstrated in both myself and others.

But just the same this line of reason seemed to me to account for the large doses of educational and training material we usually prescribe for the other fellow in our typical training program. I'm afraid sometimes that the large volume of general information offered in relation to the relatively small amount the average individual is able to absorb accounts for the very serious attendance problem we find in training.

Training Material

A short time ago I reviewed the back material presented during the past year to the supervisory and executive staff of a very fine organization. It was splendid material and covered practically every phase of the overall operation from finance through engineering to service and sales. While anyone would be forced to admit that every sentence in it would be worth the time required to absorb it, he would also have to admit that it would be a full-time job trying to absorb it all.

While I am sure that the relatively small portion of the information carried away by those who felt like doing it made the effort worth their while, I learned for a fact that the rank and file were pretty much swamped. Consequently, some preferred to be out on the job wrestling with some real problems they had to solve, or else. I learned too that those running this training program had a hard time trying to get the executives who were supposed to attend to come at all.

Test of Training

However most of the group did sit and suffer with mental indigestion; there wasn't anything else to do, they had to do it. I couldn't help but think of driving horses to water they wouldn't drink. As far as I can see it takes learners to make teachers and doers to make trainers. This being the case, the only test of any training scheme has got to be what the trainees carry away with them, and of even greater importance, what they do with it.

Frankly, I don't think that any of us can afford to feel that our personnel are being trained just because training activities are being carried on under the name. We certainly do require every other department in the foundry business to more than pay for its keep.

I hope I will not be classed with those who think that no personnel training is being carried on in an organization that does not have a meeting room, blackboard, books and instructors. In fact, from what I have seen in my travels, the conventional signs of training might easily cover up the fact that very little effective training is being done by those whose job it is to do it.

Every once in a while I catch myself losing sight of the fact that, regardless of the value of group training, the bulk of the result producing training in an organization will always have to be carried on man to man on a private tutor basis in a two-man school, with the boss the trainer and the employe the trainee.

Time and again, in trying to find out why a training activity was not more effective I have traced it to a conflict between what trainees were being taught by their instructors in groups and what they were told on the job by their bosses. I have run into many specific instances where the boss has said to his trainee employe, "I don't care what they told you in the meeting, this is the way we do it here!" I don't see how we can avoid the fact that when we get right down to it most of what an individual has got to know to do his job must be learned on the job.

Accident Prevention Training

I think you will all agree that one of the toughest training jobs in industry is in connection with the prevention of accidents. Quite some years ago a friend of mine, the safety director of a large organization, became pretty much dissatisfied with the accident prevention results coming from the conventional safety activities then being carried on. While he realized that safety contests, safety schools, committees, bulletins and literature all had their place, they were not enough.

I won't take the time to tell you all the steps he took to arrive at his present plan. Today throughout his organization the main feature of his program calls for the foreman to:

1. Determine every safety "do" and "don't" on each job and operation in the department.
2. See to it that each employe

knows each safety "do" and "don't" on a job before he takes that job.

3. Personally contact each employe on the job, regularly at specific intervals and see to it that the employe has not forgotten his safety "do's and don'ts" and is working accordingly.

This, of course, is far from being all of the program, but it certainly is the backbone of it and the results so far have proved it to be sound.

Personal Basis

I sometimes wonder as I visit foundries and factories throughout the country whether we aren't trying to carry the mass production idea too far or at least into the wrong field. Maybe we are trying to mass produce personnel like we do castings and products. Maybe we are trying to rig up patterns to do what patterns were never intended to do—jobs that can only be done by persons on a man-to-man basis.

One of my foundry friends told me while we were discussing this subject of management's stake in personnel training that one of the real and critical bottlenecks in a great many foundries today, both large and small, was the result of having too few men who were qualified to answer the many questions which come up every day in the normal course of our work. He mentioned several instances where the whole operation hinged on one or two badly overworked individuals, and the whole operation dragged.

In this day and age, when most of our foundries specialize in some particular type of work, the chances of hiring ready-made, already trained personnel are pretty slim, it seems to me. If my impressions are correct, there aren't many new employes who can step right into a new job and start clicking right off the bat, and it seems to me that this applies not only to the shakeout man or operator but to members of supervision right up to a new manager.

Distribution of Load

In fact, just last week a manager friend of mine, on his new job for only a year, told me confidentially that he had done little else since he had been there but go to school, with his staff as instructors.

If all this is true, and if the distribution of the management load is one of the important bottlenecks in the foundry organization, then it seems to me that each member of the management team, regardless of his post, must recognize that he holds two positions in common with all of his associates: (1) the position of student and (2) the position of instructor.

It seems to me that if each of us could place himself in each of these two positions while assuming the responsibilities they imply, management's stake in personnel training would be bound to pay off in a big way.

With every one in management recognizing themselves in their double role of student and instructor, the dangerous "let George do it" fallacy would fall to the ground. Under these circumstances, maybe the manager would knock off for a spell, sit down and jot down the "do's" and the "don'ts" of the jobs he assigns his staff members.

Perhaps each of his staff members, by example, would also sit down and figure out the "do's" and the "dont's" of the jobs he assigns his superintendents or general foreman. Then the general foreman or superintendent, to be in style, would do likewise for their foremen, with the foremen following suit.

Training Instructors

In such a program I'd be willing to bet, particularly if I were a part of it, that we wouldn't get very far as instructors till we found the need for training ourselves. Then, if all these needs were admitted and gathered together, what an effective training program we would have.

Personally I like this research approach to the training of personnel for the foundry, because everybody would be in it, everybody would be doing it, no one would be lonesome—it would be the American way and democratic way. With every one of us fully aware of what there is to learn and our responsibility for sharing what little we know with others, we would accomplish far more than our training job—as a by-product we would develop the foundation of a profit producing and mutually beneficial man-to-man relationship.

With the line organization recognized as the authentic faculty of our training school and principal training agency, we can then supplement this agency with all the devices, meeting rooms, blackboard charts, books and professors our needs call for or our pocketbooks will permit.

I do hope that in my effort to emphasize personnel training as being primarily the function and responsibility of the line organization that I have not belittled the need for all of the supplementary education we can make available for our people.

The thing I have tried to do is to discourage the idea that our personnel can be trained effectively on an assignment basis as we might go about having the factory buildings painted—select a good painter, tell him what we want and then dismiss the subject till the job is completed. I am sorry to say that this procedure is being attempted and with very unsatisfactory results both to those who want the training job done and those who are hired to do it.

Enter Apprentices Now In 1948 A.F.A. Contest

SINCE THE 1948 A.F.A. Apprentice Contest opened last November 10, contestants have kept the patterns in circulation and nearly depleted the original stock of blueprints.

Open to apprentices in foundry and patternmaking who meet requirements listed in the regulations, the contest provides for prizes of $100, $50, $25 in each of four contest divisions. The first prize winner in each division will have round trip rail fare and Pullman berth paid by the Association to enable him to attend the A.F.A. convention in Philadelphia, May 3-7.

Five A.F.A. chapters are conducting local contests and others are expected to send official word on local contests soon. The five are Wisconsin, Northeastern Ohio, Philadelphia, Detroit, and British Columbia.

Contestants may enter on a plant basis as well as a chapter basis and many foundries, some represented in the contest since it originated in 1924, have entered the 1948 competition.

The last date for entering the 1948 contest is March 15. Judging will take place in Philadelphia at a time and place to be announced.

Information on the A.F.A. Apprentice Contest may be secured from the chairman of any A.F.A. chapter educational committee or from the American Foundrymen's Association, 222 W. Adams, St., Chicago 6, Ill.

★ NEW A. F. A. MEMBERS ★

Period December 15, 1947 - January 15, 1948 - New members reported by 31 chapters and one student chapter is 247. Leading chapters: Eastern New York, 49; Chicago, 29; Quad City, 22; University of Minnesota Student Chapter, 17; Detroit, 14; and Ontario, 13. Is your chapter growing?

NEW COMPANY MEMBERS

Albany Castings Co., Inc., Voorheesville, N.Y.—Charles E. Blumenauer, Vice-Pres. (Eastern New York Chapter)
Eddy Valve Co., Waterford, N.Y.—K. F. Echard (Eastern New York Chapter)
Erie Castings Co., Erie, Pa.—K. T. Guyer, Pres. (Northwestern Pennsylvania Chapter)
Federal Foundry Supply Co., New York—Walter F. Kane (Eastern New York Chapter)
Hillsdale Foundry Corp., Hillsdale, N.Y.—H. G. Hinrichs, Pres. (Eastern New York Chapter)
J. I. Case Co., Bettendorf, Iowa—K. R. Ford (Quad City Chapter)
James Hunter Machine Co., North Adams, Mass.—Paul C. Wilson, Supt. (Eastern New York Chapter)
M. B. M. Foundry, Inc., Garfield Heights, Ohio—Wm. C. Manwell, Pres. (Northeastern Ohio Chapter)
Rathbun-Jones Engr. Co., Toledo, Ohio.—George Rathbun, Jr. (Toledo Chapter)

CANTON DISTRICT CHAPTER

E. A. Allan, Pres., Wadsworth Equipment Co., Akron, Ohio.
John R. Kerr, Jr., Asst. Frm., Deming Co., Salem, Ohio.
Oswald Morgan, Owner, Parkway Pattern, Alliance, Ohio.
Joseph Pawol, Gen. Mgr., General Alloy Casting Co., Rochester, Pa.
Albert R. Proffit, Frm., Parkway Pattern, Alliance.

CENTRAL ILLINOIS CHAPTER

Everett Eakle, Frm., Caterpillar Tractor Co., Peoria.

CENTRAL INDIANA CHAPTER

Charles P. Graves, Perfect Circle Corp., New Castle.

CENTRAL NEW YORK CHAPTER

Jas. M. Hutton, Research & Devp., Precision Casting Co., Inc., Fayetteville.

CENTRAL OHIO CHAPTER

Harry M. Flegal, Mgr., The Zanesville Sand Co., Zanesville.
Harry J. Grashel, Asst. Plant Supt., Chase Fdry. & Mfg. Co., Columbus.
John W. Lambert, Furnace Foundry Co., Jackson.
F. M. Pritchett, Cedar Heights Clay & Coal Co., Oak Hill.

CENTRAL MICHIGAN CHAPTER

Steve Podauka, Frm., Albion Mall. Iron Co., Albion.

CHESAPEAKE CHAPTER

William Clarke, Foreman, Maryland Car Wheel Co., Baltimore, Md.
J. E. Minchew, Supt., Brake Shoe & Cstgs., Div., American Brake Shoe Co., Portsmouth, Va.
Joseph R. Wertime, Fdry. Met., T. B. Wood's Sons Co., Chambersburg, Pa.

CINCINNATI DISTRICT CHAPTER

Leslie H. Covey, Fdry. Supv., The Williamson Heater Co., Cincinnati.
John Glynn, Fdry. Supt., The United States Electrical Tool Co., Williamsburg, Ohio.
David J. Pusack, Met., Cincinnati Milling Machine Co., Cincinnati.

CHICAGO CHAPTER

Paul J. Bauman, Sales, American Brake Shoe Co., Chicago.
George Bowdish, Salesman, The Hill & Griffith Co., Chicago.
Robert D. Buckley, Prog. Student, International Harvester Co., Chicago.
Clarence F. Casazza, Vice-Pres., North American Fdry., Inc., Chicago.
Henry F. Dake, Asst. Gen. Supt., The Pyle National Co., Chicago.
Ronald Danner, Frm., Western Foundry Co., Chicago.
Robert T. Dorgan, Fdry. Prog. Student, International Harvester Co., Chicago.
Chas. A. Flatray, Frm., Pettibone Mulliken Corp., Chicago.
G. Fredericks, American Brake Shoe Co., Chicago.
Earl W. Ganslein, Res. Met., American Steel Foundries, East Chicago, Ind.
Alvin E. Jacobson, Jr., Res. Engr., Crane Co., Chicago.
E. R. Jerome, Met. Asst., American Brake Shoe Co., Chicago.
A. Mac Nab, Supt., Brake Shoe & Cstgs. Div., American Brake Shoe Co., Chicago.
Paul L. Mangold, Service Engr., Swan-Finch Oil Corp., Chicago.
G. Edward Marckes, Sales & Ser. Engr., The Beardsley & Piper Co., Chicago.
M. D. Mason, Master Mech., American Brake Shoe Co., Chicago.
H. A. Maxon, Frm., American Mang. Steel Div., American Brake Shoe Co., Chicago.
John E. Miller, Sales Engr., Miller & Co., Chicago.
P. Murray, Frm., American Mang. Steel Div., American Brake Shoe Co., Chicago.
Clarence Peper, Fdry. Frm., Pyle National Co., Chicago.
Harold F. Redman, Pres. North American Fdry Inc., Chicago.
John Rensink, Prog. Student, International Harvester Co., Chicago.
Frank Rudny, Fdry. Supt., Pyle National Co., Chicago.
A. Saia, Frm., American Mang. Steel Div., American Brake Shoe Co., Chicago.
Myron W. Scott, Mech. Mgr., The Pyle National Co., Chicago.
A. G. Shafer, Asst. Div. Engr., American Mang. Steel Div., American Brake Shoe Co., Chicago.
Andrew Van Echo, Met., Wm. E. Pratt Mfg. Co., Joliet, Ill.
Thomas R. Whitacre, Dist. Sls. Repr., The Federal Foundry Supply Co., Chicago.
V. Wilkins, Frm., American Mang. Steel Div., American Brake Shoe Co., Chicago.

DETROIT CHAPTER

Robert W. Bachelder, Student, Pontiac Motor Div., General Motors Corp., Pontiac, Mich.
George E. Castle, Time Study Engr., Commerce Pattern Foundry & Machine, Detroit.
Samuel J. Catanese, Supv., Commerce Pattern Foundry & Machine, Detroit.
Thomas J. Flanigan, Slsmn., Federated Metals Div., American Smelting & Refining Co., Detroit.
Glenford D. Fry, Chief Engr., Gordon Mfg. Co., Ltd., Wallaceburg, Ont., Canada.
Carl M. Gaebler, Met., Commerce Pattern Foundry & Machine Co., Detroit.
John C. Gould, Partner, Perfection Pattern & Mfg., Detroit.
W. Roy Gould, Partner, Perfection Pattern & Mfg. Co., Detroit.
Robert McGaffey, Frm., Gordon Mfg. Co., Ltd., Wallaceburg, Ont., Canada
Lee M. Mohnkern, Frm., Pattern Dept., Detroit Steel Castings Co., Detroit.
F. F. Rotrock, Gen. Supt. of Core Rm., Wilson Foundry & Machine Co., Pontiac, Mich.
Frank F. Rycamber, Gen. Frm., Cadillac Motor Car Div., Gen. Motors Corp., Pontiac, Mich.
Harold M. Simon, Supt., Detroit Steel Castings Co., Detroit.
George R. Wlodyga, Bohn Aluminum & Brass Corp., Detroit.

E. CANADA & NEWFOUNDLAND CHAPTER

Charles H. Atkinson, Sales Repr., George F. Pettinos Ltd., Hamilton, Ont.
Gaston Dupuis, Student, Trois-Rivieres, Que.
George R. Ewan, Met. Dept., Dominion Engineering Works Ltd., Montreal, Que.
J. E. Mayo, Student, Montreal Technical School, Montreal.
Roger Parent, Student, Montreal Technical School, Montreal.
Eugene Renaud, Precision Casting Devel., B. G. Manufacturing, Verdun, Que.
Rudolph Weisner, Canadian Pratt & Whitney Co., Ltd., Longueuil, Que.

EASTERN NEW YORK CHAPTER

Earle W. Aumic, Frm., General Electric Co., Schenectady.
John E. Biggerstaff, Asst. Frm., American Locomotive Co., Schenectady.
***Albany Castings Co., Inc., Voorheesville. (Charles E. Blumenauer, V.P.)**
Howard H. Bodwell, Planner & Rate Setter, General Electric Co., Schenectady.
William F. Bunk, Core Maker, American Locomotive Co., Schenectady.
Theodore O. Carlson, Frm., General Electric Co., Schenectady.
James Demarisco, Core Rm. Frm., James Hunter Machine Co., North Adams, Mass.
***Eddy Valve Co., Waterford. (K. F. Echard.)**
Herbert Fearnley, Fdry. Frm., Ramsey Chain Co., Inc., Troy.
Crawford Flagg, Pattern Frm., American Locomotive Co., Schenectady.
Norton B. Duel, Ramsey Chain Co., Albany.
Phillip A. Gould, Cleaning Frm., James Hunter Machine Co., North Adams, Mass.

* Company Members

Wm. L. Hebenstreet, Pattern Frm., Adirondack Foundry & Steel, Watervliet.
C. C. Henegar, Fdry. Supt., Production Pattern Co., Chicopee, Mass.
Harry Heron, Molder, American Locomotive Co., Schenectady.
***Hillsdale Foundry Corp., Hillsdale. (Hans G. Hinrichs, Pres.)**
Adam C. Hopson, Fdry. Prod. Supt., Ramsey Chain Co., Inc., Albany.
John M. Jones, Fdry. Met., American Locomotive Co., Schenectady.
***Federal Foundry Supply Co., New York. (Walter F. Kame)**
Charles E. Killmer, Sr., Salesman, Swan-Finch Oil Corp., New York.
Harold D. Killmer, Salesman, Swan-Finch Oil Corp, New York.
Joseph L. Kloss, Gang Leader, Large Core Room, American Locomotive Co., Schenectady.
Stanley S. Kowaleski, Molder, American Locomotive Co., Schenectady.
Robert W. MacArthur, Student, Ramsey Chain Co., Albany.
Scott Mackay, Prof. Met. Engr., Rensselaer Polytechnic Institute, Troy.
A. Marchant, Chief Insp., Adirondack Foundries & Steel, Inc., Watervliet.
John P. Marra, Chemist, American Locomotive Co., Schenectady.
Harvey J. McGowan, Div. Frm., American Locomotive Co., Schenectady.
George Moore, Fdry. Supt., Adirondack Foundries & Steel, Inc., Watervliet.
L. F. Mulholland, Engr. of Tests, American Locomotive Co., Schenectady.
Ugo Navarette, Frm., General Electric Co., Schenectady.
Leonard G. Nelson, Supt., Steel Fdry., Ludlow Valve Mfg. Co., Inc., Troy.
Magnus Nesheium, Fdry. Supt., Rensselaer Valve Co., Troy.
Joseph J. Noga, Supv. Insp., American Locomotive Co., Schenectady.
C. J. Patterson, Asst. Gen. Frm., General Electric Co., Schenectady.
C. L. Richards, Met., Adirondack Foundries & Steel, Inc., Watervliet.
Harold L. Rost, Buyer, Castings & Patt., General Electric Co., Schenectady.
Leo M. Scuppy, Mgr., Scully Foundry & Machine Co., Coxsackie.
Richard Sees, Jr., Co-Partner, Capitol Brass Foundry, Albany.
Daniel B. Slater, Expediter, General Electric Co., Schenectady.
William J. Smith, Melter, American Locomotive Co., Schenectady.
Richard W. Thomas, Special Assgn., General Electric Co., Schenectady.
Alexander Thompson, Molding Frm., James Hunter Machine Co., North Adams, Mass.
John E. Waugh, Fdry. Supt., General Electric Co., Schenectady.
J. H. Wheeler, Treas., Wheeler-Bros. Brass Founders Inc., Troy.
J. N. Wheeler, Pres., Wheeler-Bros. Brass Founders Inc., Troy.
Robert L. Wickes, Sales Repr., E. F. Houghton & Co., Philadelphia.
***James Hunter Machine Co., North Adams. (Paul C. Wilson, Supt.)**
J. O. Zasada, Core-Rm. Leader, American Locomotive Co., Schenectady.

METROPOLITAN CHAPTER

I. M. MacLeod, Met., American Brake Shoe Co., Southern Wheel Div., New York.
G. A. Risley, Supv. of Safety, American Brake Shoe, Southern Wheel Div., New York.
Ernest H. Rubovitz, Pres., Newark Pattern Works, Newark, N.J.
Stanley Rudball, Molder, Eastern Malleable Iron Co., Naugatuck, Conn.
Milton Teich, Sales Repr., E. F. Houghton & Co., Philadelphia.
Andrew Vee, Asst. Met., American Brake Shoe Co., Mahwah, N.J.

MICHIANA CHAPTER

William D. Manly, Grad. Asst., Met. Dept., University of Notre Dame, Notre Dame, Ind.
C. L. Machling, Purchasing Agt., Dodge Mfg. Corp., Mishawaka, Ind.
Kenneth P. Tortorici, Appr. Wood Pattern Maker, Weil-McLain Co., Michigan City, Ind.

NORTHERN CALIFORNIA CHAPTER

Tony Aiello, Core Rm. Frm., General Metals Corp., Oakland.
William A. Scott, Cupola Tender, Mare Island Naval Shipyard, Vallejo.

NORTHEASTERN OHIO CHAPTER

Fred J. Barker, Pres., Rankin Pattern & Casting Co., Euclid.
Carl L. Eppich, Appr. Patternmaker, Standard Pattern Works, Cleveland.
J. E. Johnson, Sales Engr., Ingersoll-Rand Co., Cleveland.
Donald L. Kozeni, Met., Taylor & Boggis Foundry, Euclid.
***M.B.M. Foundry, Inc., (Wm. C. Manwell, Pres.) Garfield Heights.**
P. J. May, Salesman, Cleveland Quarries Co., Cleveland.
Easton Rankin, Sec. & Gen. Mgr., Rankin Pattern & Casting Co., Euclid.
E. N. Reusser, Fdry. Supt., Electric Alloys Div., American Brake Shoe Co., Elyria.

NORTHWESTERN PENNSYLVANIA CHAPTER

Frederich H. Diemert, Vice-Pres., Erie Castings Co., Erie.
Jacob Diemert, Frm., Erie Castings Co., Erie.
Paul W. Green, Control Chemist, General Electric Co., Erie.
***Erie Castings Co., Erie. (Kenneth T. Guyer, Pres.)**
Joseph Holsinger, Fdry. Tech., Johnson Bronze Co., New Castle.

ONTARIO CHAPTER

N. Henning Assens, Mech. Engr., Massey-Harris Co., Ltd., Brantford.
George R. Clark, Asst. Supt., Otaco Ltd., Orillia.
George G. Cleary, Supt., Massey-Harris Co., Brantford.
Lindsay Cooper, Stud. Indus. Train. Course, Massey-Harris Co., Brantford.
Lorne Farley, Frm. Patt. Mod., Massey-Harris Co., Ltd., Brantford.
Fred Jobson, William Kennedy & Sons Ltd., Owen Sound.
Irving Kennedy, Fdry. Supt., Massey-Harris Co., "M" Fdry., Brantford.
William R. Laughlen, Asst. to Wks. Mgr., Massey-Harris Co., "M" Fdry., Brantford.
J. E. Lindsay, Met., Light Alloys Ltd., Renfrew.
R. E. Matthews, Patt. Shop Frm., Eureka Foundry & Mfg. Co., Ltd., Woodstock.
John Peacock, Fdry. Frm., Anthes Fdry. Ltd., Winnipeg.
Glen Phelps, Mech. Engr., Fdry. Div., Otaco Ltd., Orillia.
Paul Woike, Asst. Fdry. Frm., Anthes Foundry Ltd., Winnipeg.

OREGON CHAPTER

Alfred Ferritti, Partner, Milwaukie Brass & Aluminum Works, Milwaukie, Ore.
Roland J. Swapp, West Coast Pattern Works, Portland.

PHILADELPHIA CHAPTER

M. J. Compty, Pres., Industrial Machine & Equipment Co., Philadelphia.
W. T. Peden, Night Supt., American Manganese Steel Div., American Brake Shoe Co., New Castle, Del.
Stewart A. Wick, Tech. Engr., New Jersey Silica Sand Co., Millville, N.J.
Howard J. Williams, Sales Mgr., New Jersey Silica Sand Co., Millville, N.J.

QUAD CITY CHAPTER

Joe Bruneel, Union Malleable Iron Works, Deere & Co., Moline, Ill.
Ernest Bull, Labor Frm., J. I. Case Co., Bettendorf, Iowa.
A. A. Carlson, Asst. Patt. Shop Supt., J. I. Case Co., Bettendorf.
Charles M. Carmack, Master Mech., Union Malleable Iron Works, Deere & Co., Moline.
Walter M. Carpenter, J. I. Case Co., Bettendorf.
J. E. Evans, Prod. Contl. Supt., J. I. Case Co., Bettendorf.
***J. I. Case Co., Bettendorf. (Kenneth R. Ford)**
C. F. Grumley, Purch. Agent, J. I. Case Co., Bettendorf.
J. M. Henchal, Headford Bros. & Hitchins Foundry Co., Waterloo, Iowa.
Raymond E. Hinds, Treas. & Purch. Agent, Riverside Foundry, Davenport, Iowa.
Thomas H. Jones, Frm., J. I. Case Co., Bettendorf.
James Lardner III, Fdry. Engr., John Deere Planter Works, Moline, Ill.
C. D. McConnell, Dir. of Ind. Rel. & Personnel, Union Malleable Iron Works, Deere & Co., Moline.
David W. McDowell, Jr., Asst. Prof., Iowa State College, Ames, Iowa.
James E. Mitchell, Indus. Rel. Supv., J. I. Case Co., Bettendorf.
Buck Murry, Asst. Maint. Supt., J. I. Case Co., Bettendorf.
Alfred Nebblin, Core Rm., Assem. Frm., J. I. Case Co., Bettendorf.
Orbille Pomeroy, Elec. Frm., J. I. Case Co., Bettendorf.
Roy P. Ray, Cleaning Dept. Frm., J. I. Case Co., Bettendorf.
Charles Wilson, Maint. Supv., J. I. Case Co., Bettendorf.
William A. Woeckener, Fdry. Supv., J. I. Case Co., Bettendorf.
Vernon G. Peters, M. E. Student, Iowa State College, Ames.

ROCHESTER CHAPTER

Clarence G. Millner, Supt., American Brake Shoe Co., Rochester.
Harry C. Platt, Div. Met., American Brake Shoe Co., Rochester.
Ray P. Schwartz, Partner, Genessee Pattern Works, Rochester.
D. R. Steele, Met. Engr., Engineered Castings Div., American Brake Shoe Co., Rochester.

ST. LOUIS DISTRICT CHAPTER

Frank Barclay, General Steel Castings Corp., Granite City, Ill.
Clyde H. Bilderback, Frm., Semi-Steel Castings Co., St. Louis.
George Elam, Slsmn., Federated Metals Div., American Smelting & Refining Co., Whiting, Ind.
Winfred Gipson, Frm., Semi-Steel Casting Co., St. Louis.
Ray Becker, Gen. Frm., General Steel Castings Corp., Granite City.

SOUTHERN CALIFORNIA CHAPTER

M. L. King, Frm., Rich Mfg. Co., Los Angeles.
T. J. Ruddy, Slsmn., H. E. McGowan Co., Los Angeles.
Guner D. C. Stenberg, Maint. Frm., Rich Mfg. Co., Los Angeles.
Richard L. VaLentine, Cupola Frm., Rich Mfg. Co., Los Angeles.
Ernest R. Wennerholm, Owner, Onard Aluminum & Bronze Foundry, Onard.

TEXAS CHAPTER

Charles L. Buck, Pattern Supv., Texas Electric Steel Casting Co., Houston.
J. L. Ennis, Standards Dept., Texas Electric Steel Casting Co., Houston.
L. C. Hollien, Night Mold. Supv., Texas Electric Steel Casting Co., Houston.
Richard Kasperek, Supv., Mold Dept., Texas Electric Steel Casting Co., Houston.
Wallace C. Kunkel, Mold. Frm., Texas Electric Steel Casting Co., Houston.
J. N. McCarroll, Clean, Rm. Supv., Texas Electric Steel Casting Co., Houston.
Ben Neman, Owner, Temple Iron Works, Temple.
John Sherrill, Chief Insp., Texas Electric Steel Casting Co., Houston.

TIMBERLINE CHAPTER

D. L. Frodine, Field Repr., Appr. Training Service, U. S. Dept. of Labor, Denver.
Raymond L. Grimes, V.P., & Gen. Mgr., Walker Foundry & Mfg. Co., Denver.
E. C. Thompson, Asst. Sls. Mgr., The Colorado Fuel & Iron Corp., Denver.

TOLEDO CHAPTER

A. G. Edwards, Fdry. Follow-up, National Supply Co., Toledo.
***The Rathbun-Jones Engr. Co., Toledo. (George Rathbun, Jr.)**
Joe Rice, Plt. Engr., Hillsdale Foundry, Hillsdale, Mich.
Harry Stahl, Freeman Supply Co., Toledo.
Fred R. Young, Sls. Engr., E. A. Wilcox Co., Seattle, Wash.

* Company Members

* Company Members

TWIN CITY CHAPTER

Richard W. Wilson, Asst. Met., American Hoist & Derrick Co., St. Paul, Minn.

UNIVERSITY OF MINNESOTA STUDENT CHAPTER

Robert C. Bradley, Student, University of Minnesota, Minneapolis.
Harold U. Bruhjell, Student, University of Minnesota.
Harry R. Carlson, University of Minnesota.
Chester E. Denno, Student, University of Minnesota.
Richard E. Fisher, Student, University of Minnesota.
Francis J. Green, Student, University of Minnesota.
John E. Hormanson, Student, University of Minnesota.
David J. Huch, Student, University of Minnesota.
Mark Irwin, Student, University of Minnesota.
Wesley J. Preble, Student, University of Minnesota.
Herman Rischall, Student, University of Minnesota.
Harvey Sauby, Student, University of Minnesota.
Ted M. Swanson, Student, University of Minnesota.
Howard Tomaske, Student, University of Minnesota.
Herbert Andrew Widell, Student, University of Minnesota.
Donald J. Woodhoose, Student, University of Minnesota.
Robert L. Zak, Student, University of Minnesota.

WASHINGTON CHAPTER

William A. Snyder, Instr. of Mech. Engr., University of Washington, Seattle.
C. R. Jackson, Sales Repr., E. F. Houghton & Co., Seattle.

WESTERN MICHIGAN CHAPTER

J. L. Boles, Sales, Paul M. Weiner Foundry Co., Muskegon.
Daniel E. Connell, Emp. Mgr. No. 11, Campbell Wyant & Cannon Foundry Co., Muskegon.
Harry G. Gruen, Patt. Shop Frm., Dake Engine Co., Grand Haven.

WISCONSIN CHAPTER

T. S. Abbott, Asst. Engr., Allis Chalmers Mfg. Co., West Allis.
Donald E. Feather, Inst. University of Wisconsin, Madison.
Foster Olson, Fdry. Material Contl. Dept., Allis-Chalmers Mfg. Co., West Allis.
W. T. Lawrie, Partner, Redi-Products Co., Milwaukee.
Chester Petzke, Ampco Metal, Inc., Milwaukee.

NON-CHAPTER

Herbert T. Higginbatham, Melt. Frm., Hunt Machine Works, Inc., Greenville, S.C.

Argentina

Herberto Niedermaier, Met. Fdry., Supt., Foundries "Pelayo" S.R.L., Buenos Aires.

Australia

David F. Muller, Fdry. Engr., General Motors Holden's Ltd., Victoria.

Brazil

Alberto Paulo Ribbe, Chemist, Fabrica Nacional de Motores, Rio de Janeiro.

Holland

J. B. Ubbink, Mng. Dir., Nederlands-Amerikaanse Fittingfabriek, Doesburg.

Sweden

Kungliga Patent-Och, Registereringsverket, Biblioteket, Stockholm.

FUTURE CONVENTIONS AND EXHIBITS

American Institute of Mechanical Engineers, Annual Meeting, New York—Feb. 15-19.
American Society of Mechanical Engineers, Spring Meeting, New Orleans, La.—March 1-4.
Society of Automotive Engineers, National Passenger Car Meeting, Detroit—March 3-5.
Northeastern Ohio Chapter Regional Conference, Case Institute of Technology, Cleveland—March 11-12.
American Society of Tool Engineers, 16th Annual Meeting and Tool Exhibition, Cleveland—March 15.
Magnesium Association, 4th Annual Meeting, Pennsylvania Hotel, New York City—March 18-19.
Chicago Technical Societies Council, Chicago Production Show, Stevens Hotel, Chicago—March 22-24.
National Association of Corrosion Engineers, Jefferson Hotel, St. Louis, Mo.—April 5-8.
American Ceramic Society, 50th Annual Meeting, Chicago—April 24-30.
American Foundrymen's Association, 52nd Annual Convention and Exhibit, Philadelphia—May 3-7.
American Society of Mechanical Engineers, Semi-Annual Meeting, Milwaukee—May 30-June 4.
American Society for Testing Materials, 51st Annual Meeting, Detroit—June 21-25.

Over 10,000 A.F.A. Membership Indicates Peak Show Attendance

OVER 10,000 FOR THE FIRST TIME in 52 years of A.F.A. existence, the membership of the Association was 10,280 on December 31, 1947. This was disclosed by Secretary-Treasurer Wm. W. Maloney at the mid-year Board meeting, January 21 and 22, in Chicago.

Since 1896, when the Association was formed in Philadelphia with 345 members, the membership has grown steadily. With the formation of chapters in 1934, recognition of the value of membership in A.F.A. became more wide spread. Chapters provided industrial contacts and fellowship not then existent in the foundry industry and from then on the growth of A.F.A. was rapid. Now there are 42 chapters, including four university student groups, and another chapter will be formed soon in Chattanooga.

The membership of A.F.A. has more than doubled since 1942, making the Association the largest foundry society in the world as well as the largest technical foundry society.

Companies Want Men to Join A.F.A.

Accounting in part for the recent membership increase, some chapter membership chairmen report that many companies are sending their men to the 52nd A.F.A. Annual Meeting and Foundry Show in Philadelphia as A.F.A. members rather than as non-members. This is in accord with a trend especially noticeable last year when membership increased markedly during a brief period prior to the Annual Meeting in Detroit.

Heavy non-member registration is also expected at the five-day Foundry Congress and Show in Philadelphia May 3-7. Continuing last year's practice, the non-member registration fee may be applied on membership in the Association if application is made within 30 days after the 1948 Convention. The non-member registration fee is $1.00.

High Membership Swells Show Attendance

Total registration at Philadelphia probably will exceed the all-time high of more than 18,000 recorded at the 1946 Golden Jubilee in Cleveland. The largest Foundry Show held east of Cleveland, the exhibits this year will feature new equipment not ready for showing in 1946. Many exhibitors of previous years will be at the 52nd A.F.A. Annual Meeting and Foundry Show. In addition, a number of firms which have not previously exhibited will be represented.

Interest in this year's Annual Meeting arises from the more than 60 technical sessions and shop course meetings, as well as the exhibits of equipment and supplies. These meetings, feature papers by the top technical and operating talent of the foundry industry. The papers are available to A.F.A. members prior to the Annual Meeting and subsequently will be published in TRANSACTIONS OF A.F.A.

FOUNDRY PERSONALITIES

A.F.A. National Director **R. H. McCarroll,** director of chemical engineering and chemical and metallurgical research, Ford Motor Co., Dearborn, Mich., has been selected as one of the five judges for the Industrial Furnace Manufacturers Association contest on the best published article concerning industrial furnace, kiln or oven applications. Other judges include: **Alexander H. d'Arcambal,** vice-president, Pratt & Whitney Div., Niles-Bement-Pond Co., West Hartford, Conn.; **Dr. E. S. Davenport,** assistant to vice-president, U. S. Steel Corp., Pittsburgh, Pa.; **George W. Mason,** president, Nash-Kelvinator Corp., Detroit; and **Dr. S. R. Scholes,** dean, New York School of Ceramics, Alfred University, Alfred, N.Y.

Thomas B. Hasler, formerly president, Wilson Welder & Metals Co., Inc., New York, a wholly owned subsidiary of the Air Reduction Co., Inc., was elected chairman of the board of directors succeeding **C. E. Adams** who resigned as chairman and director; and **F. B. Adams, Jr.,** was elected president and a director.

Mr. Hasler has been president of the firm for twenty-nine years.

L. A. Cornelius, who founded the Wolverine Brass Works, Grand Rapids, Mich., in 1896, and has been the firm's president since 1899, has been elected chairman of the board of directors.

Laurence Cornelius, the founder's son, who has been with the corporation for 32 years, has been named president. He has been vice-president since 1926.

L. B. McKnight, who joined Chain Belt Co., Milwaukee, in 1927, has been elected vice-president of the two heavy machinery divisions, conveyor and process equipment and construction machinery. He was formerly executive assistant to the president and was previously manager, conveyor division.

In other appointments, **O. W. Carpenter** has been elected vice-president in charge of finance and **B. F. Devine,** manager, construction machinery division, vice-president.

L. B. McKnight

J. M. Gruitch has been named director of research, American Car & Foundry Co.

F. K. McCune has been appointed assistant to the general manager, apparatus department, General Electric Co., Schenectady, N.Y.

Appointment of **John E. Dunbar** as sales manager was recently announced by Superior Foundry, Inc., Cleveland. Mr. Dunbar is a graduate from Pennsylvania State College, State College, was associated with Lycoming Motor Corp., Williamsport, Pa., for 17 years and for the past 10 years with White Motor Co. as director of purchasing.

J. E. Dunbar

J. Roy Gordon has been elected assistant vice-president, International Nickel Co. of Canada, Ltd. Also **T. H. Wickenden** has been elected vice-president of the company's United States subsidiary, the International Nickel Co., Inc., New York.

Mr. Gordon joined International Nickel in 1936 as director of research at Copper Cliff, becoming technical assistant to the vice-president in 1946.

Mr. Wickenden became associated with the company in 1922, when he was placed in charge of developments in the automobile field for the development and research division at New York. He was appointed assistant manager of the division in 1931. In 1943 he was made manager of the development and research division, which he continues to head.

Charles B. Proudfoot, formerly assistant director of the engineering and physics division, Frederic Flader, Inc., North Tonawanda, N. Y., has been engaged by the Carborundum Company as senior research engineer in physics at the company's research and development laboratory, Niagara Falls, N.Y.

Mr. Proudfoot received his Bachelor of Science degree from University of Michigan, Ann Arbor, and is a physicist and electrical engineer.

E. E. Bradway, formerly manager, industrial engineers division, Lester B. Knight & Associates, Chicago, has been elected vice-president of the company and appointed manager of the New York office.

In another appointment by the firm, **J. A. Greene,** formerly resident engineer, is now assistant chief engineer, development and installation division.

William T. Kelly, Jr., was elected first vice-president, American Brakeblok Div., American Brake Shoe Co., New York. Mr. Kelly, who has served as vice-president of American Brake Shoe since 1946, has been with the company since graduating from college in 1928.

Henry V. Erben has been elected a vice-president, General Electric Co., and becomes general manager, apparatus department. He succeeds **Roy C. Muir,** company vice-president, who has retired after more than 42 years service.

E .T. Cuddeback, for the past year sales representative in the Allis-Chalmers Atlanta district office, has been named manager of the company's Tampa district office. He succeeds **A. D. Robertson** who resigned.

Paul J. Scribner has been appointed general service manager, Automatic Transportation Co., Chicago.

John C. Wallace has retired after 34 years of service with Perfection Stove Co., Cleveland. At the time of his retirement he was vice-president and director of sales.

(*Continued on Page 80*)

J. C. Wallace

SOUTHERN CALIFORNIA HOLDS LOCAL APPRENTICE CONTEST

THE A.F.A. Annual Apprentice Contest regulations will be used as a guide in the local contest being conducted this spring by the Southern California chapter, according to chapter Educational Committee Chairman Henry W. Howell, president, Howell Foundry Co., Los Nietos.

As in the national contest, any foundry or pattern shop may enter indentured apprentices, whether they have A.F.A. affiliation or not. The contest will open in four divisions: steel, iron and non-ferrous molding and pattern making.

The Educational Committee of the chapter will furnish blueprints and patterns. A prize will be awarded to each division winner.

Gearing its program closely to that of the chapter Apprentice Training Committee, the Educational Committee is not planning local participation in the national contest because of current concentration on an apprentice training program. The local contest this year is expected to familiarize plants and apprentices in the Southern California chapter area with A.F.A. contest procedures. Heavy participation in the 1949 A.F.A. Annual Apprentice Contest is planned.

V. P. Barton, vice-president, Triplett & Barton, Inc., Burbank, chairman of the Southern California Chapter Apprentice Training Committee reports that 16 coremaking and molding apprentices and over 40 patternmaking apprentices have signed up for the apprentice training course. The patternmaking class will start as soon as applicants have been classified.

Classification of foundry apprentices is under the Classification Subcommittee headed by R. R. Gregg, foundry superintendent, Reliance Regulator Corp., Alhambra, who has just been nominated for a three year term as a National Director of the American Foundrymen's Association. The Classification Subcommittee will review the credentials of coremakers and molder apprentices and decide credit to be allowed for past experience.

Review A.F.A Casting Defects Publication

THE FIRST comprehensive information on the subject, ANALYSIS OF CASTING DEFECTS describes and illustrates 31 basic casting defects. For ready reference, causes of defects are classified under 10 specific and one general phase of foundry operation. The method of classification makes the study of a specific casting defect very easy. Each defect is defined and analyzed as to causes; where more than one factor causes a defect, the major factors have been indicated.

A two-page chart summarizing the detailed causes gives an overall picture of the probable cause of any defect. The chart shows that faulty pouring practice causes more types of defects than any other factor, with molding practice a close second. Metal composition and melting practice, metallurgists will delight in pointing out, cause the fewest number of types of defects.

Profusely illustrated and printed with type and paper selected for legibility, the book is ideal as a reference. Its use is made all the more easy by the detailed index. All defects except the most obvious such as "broken castings" are well illustrated and instructively captioned. Illustrations are keyed to defects for easy reference. Many of the illustrations were generously provided by foundries; others represent test castings which the committee developed. By changing operating factors, the committee was able to produce or eliminate defects in the test castings at will.

ANALYSIS OF CASTING DEFECTS was written primarily for gray iron foundrymen and metallurgists, but many of the defects and causes are common to other alloys.

The five millionth Maytag washer being christened with a bottle of milk by Miss Rosanne Morgan, 1947 Maytag queen. Around the washer are (left to right) V. R. Martin, President Fred Maytag II, Iowa Governor Robert D. Blue and Miss Morgan. The Maytag Company, Newton, Iowa, holds a company membership in the American Foundrymen's Association.

Al Pfeiffer Is Honored On "Shut-Ins" Program

A. F. PFEIFFER, pattern and foundry div., Allis-Chalmers Mfg. Co., Milwaukee, was recently honored over WBBM, Chicago, and the Columbia Broacasting System, for having contributed the letter of the week to the CBS program "Shut-Ins." The letter accepted for the week was addressed to Mr. and Mrs. Carl Gerbig, Main Street, Archbald, Pa. Mrs. Gerbig has been an invalid for 20 years and Mr. Gerbig, who has been taking care of her, has recently gone totally blind.

Mr. Pfeiffer, Chairman, A.F.A. Pattern Division, has gathered many names from different parts of the country and Canada to whom he sends greeting cards.

★ CHAPTER ACTIVITIES ★

news

Detroit

C. J. Rittinger
American Car & Foundry Co.
Publicity Chairman

ENTHUSIASM AND good fellowship ran high at the chapter's Institutional and Old Timers night held December 2 at the Fort Shelby Hotel, Detroit. One of the honored guests was Past Chairman J. L. Mahon, American Car & Foundry Co., Detroit.

Master of ceremonies was past Chairman A. H. Allen, Penton Publishing Co., Detroit.

Connecticut Non-Ferrous

C. A. H. Knapp
Association Reporter

THE SPEAKER, J. F. Ednie, chief metallurgist, Duquesne Smelting Corp., Pittsburgh, Pa., prefaced his remarks to the Connecticut Non-Ferrous Foundrymen's Association, by stating that, to date, there still is no agreement that test bars are representative of the castings and that his remarks would be confined to research being done on 85-5-5-5 test bars at Battelle Memorial Institute, Columbus, Ohio. This meeting was held November 19 at the Hotel Taft, New Haven, Conn., when Mr. Ednie spoke on "The Relationship of Test Bars to Castings of Non-Ferrous Metals.'

A test bar should be considered and treated as a casting by itself in order to make it a "standardized test bar" and serve as a basis for investigating the inconsistencies which everybody has experienced. "Standardized" being defined as all steps in the making to be the same in representative tests.

Variations from 43,000 tensile and 25 per cent elongation to 27,000 tensile and 11 per cent elongation are possible when cast in the same mold at the same time. The speaker contends that these inconsistencies may arise from tilting the mold, variation in height of pouring stream, lack of proper design and gas content of the metal.

The speaker prefers the horizontal Webbert with bars on each side and a riser over the center portion. He also suggested that the sprue, runner, riser and all parts be cut up and examined. Wide variations are thus revealed. Numerous slides were shown to illustrate the salient points and figures ranging from 21,000 to 35,000 psi tensile strength and 13 to 22 per cent elongation were all present in different parts of the test bar casting. Even gas was found under the riser.

Design of test bar and gas absorption and ejection during the final solidification were stressed as being important factors in variation of results.

The third annual Institutional and Old Timers Night held December 2 at the Fort Shelby Hotel, Detroit, afforded many of the members and guests an opportunity to give their vocal cords a good work out.

(Photo courtesy Vaughan Reid, City Pattern Foundry & Machine Co.)

Central Ohio

H. J. Lownie, Jr.
Battelle Memorial Institute
Chapter Reporter

ONE HUNDRED and twelve members of the chapter turned out for the annual Christmas party at the Chittenden Hotel, Columbus, on December 15. F. G. Steinebach, Penton Publishing Co., Cleveland, was the featured speaker.

Mr. Steinebach spoke on the subject of "Recent Trends in the Foundry Industry." After emphasizing the size and diversity of the industry by quoting production and employment figures, Mr. Steinebach reviewed recent developments under the three general headings of (1) technical developments, (2) modernization of plants, processes, labor relations, and public relations, and (3) the growth of cooperative efforts within the industry.

Mr. Steinebach commented that, although the past year has been a difficult one for foundrymen from the standpoint of raw materials, the indications are that the coming year will probably be no better. Bidding up of scrap prices by foundries is forcing the large integrated companies to divert more of their captive pig iron output into their steelmaking operations, thus reduc-

ing the amount of pig iron available to foundries. This cycle forces the foundries to bid even higher for the scrap and results in further curtailment of the pig iron supply.

A major purpose of Mr. Steinebach's address was revealed when he asked the foundrymen present—"Are you now making the best castings that you know how?" The present situation in the foundry industry furnishes many excuses for cutting back on casting quality. In some quarters, there is a growing feeling that foundries are showing a tendency to reduce quality rather than to face the problem squarely and to make use of the expediencies and ingenuity that have been traditional parts of the industry for many years. Foundry reputations are built in difficult periods such as are being experienced at the present time, Mr. Steinebach asserted.

Michiana

S. F. Krzeszewski
American Wheelabrator & Equip. Corp.
Chapter Reporter

AN ADDRESS on "Foundry Waste" by Joseph Lucas, Meehanite Metal Corp., New Rochelle, N.Y., was the feature of the December meeting held at the LaSalle Hotel, South Bend, Ind.

Facts, figures and slides were used to outline the various forms of foundry waste which increase operating costs. Further, the speaker stressed resultant savings acquired through better control and supervision and offered many suggestions which would greatly aid in reducing expenditures.

The November meeting was observed as National Officers Night with A.F.A. National President Max Kuniansky, Lynchburg Foundry Co., Lynchburg, Va., and Wm. W. Maloney, A.F.A. Secretary-Treasurer, Chicago, in attendance. Mr. Kuniansky was the principal speaker and his topic was "Chemically Treated Sand." His presentation of facts pertaining to the subject were in the nature of a progress report and proved to be very educational and extremely instructive.

Chicago Non-Ferrous

SOME THIRTY non-ferrous foundry men of the Non-Ferrous Founders' Society, Chicago chapter, met at the Machinery Club, Chicago, on December 4. The main topic of discussion was anticipated government controls in the non-ferrous field.

Western New York

F. L. Weaver
Weaver Materiel Service
Chapter Secretary

SEVENTY-FIVE MEMBERS and guests met at the Hotel Touraine, Buffalo, December 5, to hear F. G. Sefing, research metallurgist, International Nickel Co., New York. His remarks were directed toward "Educational Program for Casting Industry." Presiding was Chapter Chairman E. R. Jones, Lumen Bearing Co., Buffalo. Technical chairman was C. A. Harmon, Hanna Furnace Corp., Buffalo.

Mr. Sefing stressed the importance of education and apprentice training as a benefit to the foundry industry. The necessity for management to express their interest in the education and training of foundry students, by making their requirements and suggestions known to the heads of the various schools, in order to better assure that the young foundrymen are better qualified to adapt themselves to practical application within the industry was suggested.

Mr. Sefing remarked that management should make frequent visits to the schools and extend invitations for group visits to the foundry with the object of acquainting the student with practical operations. A lively discussion period followed.

Quad City

C. R. Marthens
Marthens Co.
Secretary-Treasurer

THE DECEMBER technical meeting was omitted and in its place the chapter held its annual Christmas party on the 12th at the Blackhawk Hotel, Davenport, Iowa. About 300 members and guests attended the party.

On November 17 at the Fort Armstrong Hotel, Rock Island, Ill., B. C.

Photographs portraying part of the members and guests who enjoyed the Central Ohio chapter Christmas party held December 15 at the Chittenden Hotel, Columbus.

(Photos courtesy W. H. White, Jackson Iron & Steel Co.)

Banquet scene of the annual Christmas party held by the Metropolitan chapter December 12 at the Essex House, Newark, N.J.

Yearly, National Malleable & Steel Castings Co., Cicero, Ill., was the principal speaker. Mr. Yearly gave a talk on malleable iron practice stressing modern annealing practice.

Metropolitan

W. H. Ferguson
Electro Metallurgical Sales Corp.
Chapter Reporter

NEARLY FIVE hundred members and guests enjoyed the annual Christmas party held in the Essex House, Newark, N.J., on December 12. Following dinner a full evening of entertainment, which included a floor show, was well received.

No. Illinois-So. Wisconsin

Carl Dahlquist
Greenlee Bros. & Co.
Chapter Technical Secretary

THE CHAPTER was host to over 500 foundrymen at the chapter's annual Christmas party held December 13 at the Faust Hotel, Rockford, Ill. Following dinner a floor show was put on to the enjoyment of all who attended the Christmas party.

John Bing, A. P. Green Fire Brick Co., Milwaukee, "shot" the Northern Illinois-Southern Wisconsin chapter Christmas party in grand style.

Western Michigan

D. A. Paull
Sealed Power Corp.
Chapter Reporter

THE ANNUAL Christmas party of the chapter was held December 12

CHAPTER MEETINGS
FEBRUARY-MARCH

FEBRUARY 16
QUAD CITY
Fort Armstrong Hotel
Rock Island
L. P. ROBINSON
Werner G. Smith Co.
Let's Stop Guessing in the Core Room

FEBRUARY 17
EASTERN NEW YORK
Circle Inn, Albany
A. W. GREGG
Whiting Corp.
Mechanization of the Small Foundry

FEBRUARY 18
TOLEDO
Toledo Yacht Club
L. W. DEAN
Precision Casting Co.
Precision Castings

FEBRUARY 19
DETROIT
Rackham Educational Memorial
V. A. CROSBY
Climax Molybdenum Co.
Selection of Iron for Automotive Use
H. L. SMITH
Federated Metals Div.
American Smelting & Refining Co.
Brass and Bronze Melting
E. C. ZIRLOW
National Malleable & Steel Castings Co.
Malleable Foundry Sands
W. W. FULLER
Detroit *News*
I'm Telling You

NORTHWESTERN PENNSYLVANIA
(Sub Group)
Exchange Hotel, Oil City
R. L. LEE
General Motors Corp.

OREGON
Heathman Hotel, Portland
O. H. ROSENTRETER
National Engineering Co.
Sand Conditioning Units for Small Foundries

FEBRUARY 20
TEXAS
Fort Worth
M. I. DORFAN
American Wheelabrator & Equipment Co.
Dust and Fume Control

WASHINGTON
Gowman Hotel, Seattle
VENA DENNY
American Foundry

TRI-STATE
Hotel Mayo, Tulsa, Okla.
F. W. HANSON
Electro Metallurgical Co.
Alloy Cast Iron and Steel

FEBRUARY 23
NORTHWESTERN PENNSYLVANIA
Moose Club, Erie, Pa.
C. F. JOSEPH
Central Foundry Div., General Motors Corp.

CENTRAL OHIO
Chittenden Hotel, Columbus
L. C. TATE
Ford Motor Co.
Measurement of Temperatures of Molten Metal

J. H. LANSING
Malleable Founders' Society
Malleable Iron Founding

FEBRUARY 27
CHESAPEAKE
Engineers Club, Baltimore, Md.
DONALD POTTER
Stewart Warner Corp.
Precision Casting

ONTARIO
Royal York Hotel, Toronto
ROUND TABLE DISCUSSION

MARCH 1
CHICAGO
Chicago Bar Association
L. P. ROBINSON
Werner G. Smith Co.
Let's Stop Guessing in the Core Room

METROPOLITAN
Essex House, Newark, N.J.
NATIONAL OFFICERS NIGHT
A.F.A. National President
MAX KUNIANSKY
T. W. CURRY
Lynchburg Foundry Co.
Chemically Bonded Molding Sand

CENTRAL INDIANA
Athenaeum, Indianapolis
C. R. SIMMONS
Durez Plastic & Chemicals, Inc.
Plastic Patternmaking

MARCH 2
MICHIANA
Elkhart, Ind.
H. M. ST. JOHN
Crane Co.
Quality Control in the Brass Foundry

MARCH 4
TWIN CITY
Covered Wagon, Minneapolis
S. D. MARTIN
S. W. HEALY
General Motors Corporation
Progress with Motion Study and Better Methods

ROCHESTER
Rochester Club
NATIONAL OFFICERS NIGHT
A.F.A. National Vice-President
W. B. WALLIS
Pittsburgh Lectromelt Furnace Corp.
European Foundry Practice

MARCH 5
WESTERN NEW YORK
Hotel Touraine, Buffalo
NATIONAL OFFICERS NIGHT
A.F.A. National Vice-President
W. B. WALLIS
Pittsburgh Lectromelt Furnace Corp.
J. B. CAINE
Sawbrook Steel Castings Co.
Scabs, Buckles and Spalls

MARCH 8
CENTRAL ILLINOIS
Jefferson Hotel, Peoria
F. J. WELLAVER
Falk Corporation
Welding in the Manufacture of Steel Castings

CINCINNATI DISTRICT
Engineering Society Headquarters
NATIONAL OFFICERS NIGHT
A.F.A. National President
MAX KUNIANSKY
T. W. CURRY
Lynchburg Foundry Co.
Chemically Bonded Molding Sand

WESTERN MICHIGAN
Schuler Hotel, Grand Haven
W. B. GEORGE
R. Lavin & Sons, Inc.
Metallurgy in the Brass Foundry

MARCH 9
ROCHESTER
Seneca Hotel
R. A. QUADT
American Smelting & Refining Co.
Aluminum Foundry Practice

NO. ILLINOIS-SO. WISCONSIN
Faust Hotel, Rockford, Ill.
OPEN DISCUSSION

MARCH 11
CANTON DISTRICT
Portage Hotel, Akron
QUIZ NIGHT

ST. LOUIS
York Hotel, St. Louis
S. C. MASSARI
American Foundrymen's Assn.
Present-Day Cupola Operation

MARCH 11-12
NORTHEASTERN OHIO
OHIO REGIONAL FOUNDRY CONFERENCE
Case Institute of Technology, Cleveland

MARCH 12
CENTRAL NEW YORK
Onondago Hotel, Syracuse
F. J. WURSCHER
Chicago Railway Equipment Co.
Foundry Cokes

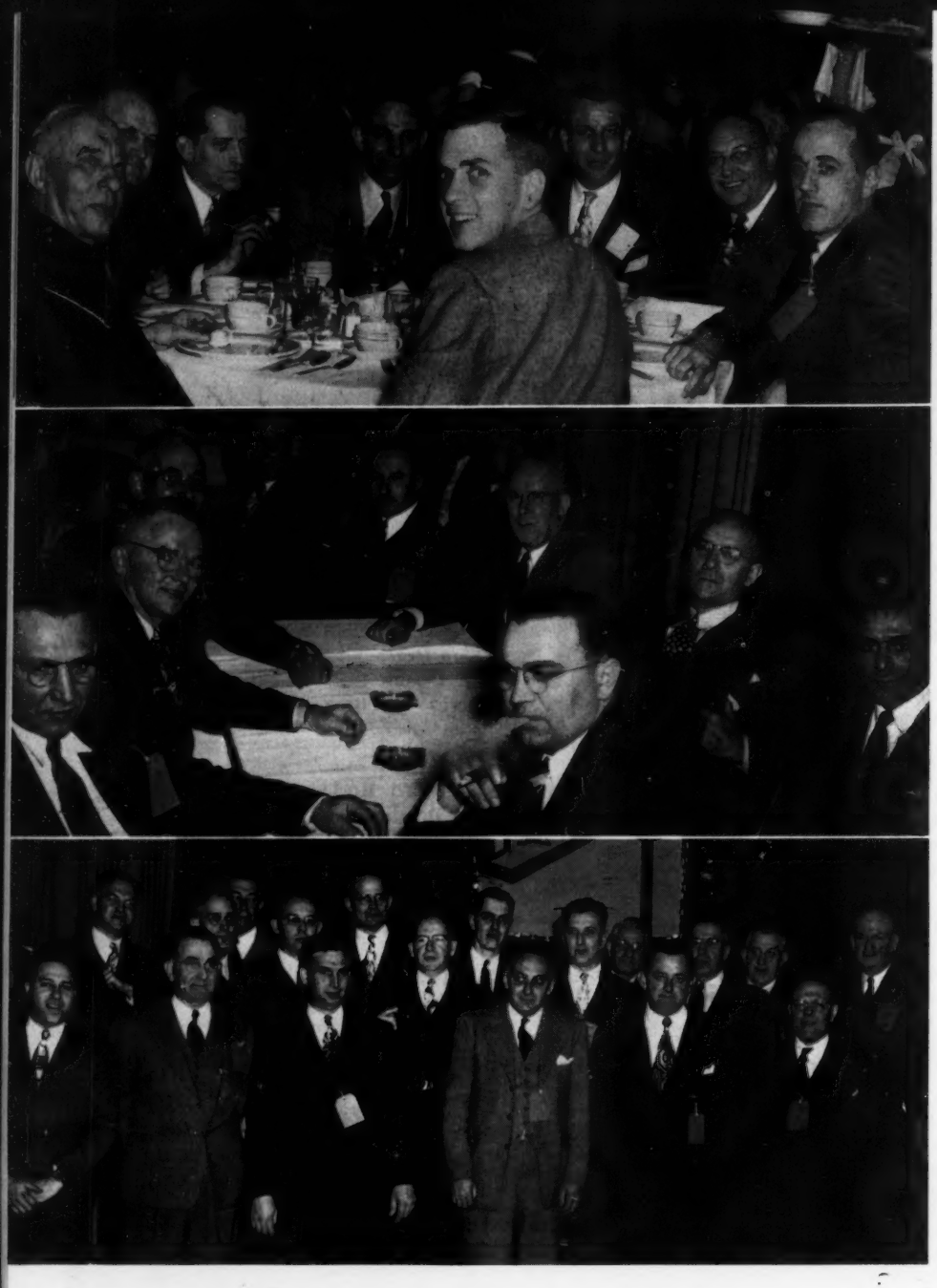
PHILADELPHIA
Engineers Club
NON-FERROUS NIGHT

E. CANADA & NEWFOUNDLAND
Mount Royal Hotel, Montreal
NATIONAL OFFICERS NIGHT
A.F.A. National Vice-President
W. B. WALLIS
Pittsburgh Lectromelt Furnace Corp.

WISCONSIN
Schroeder Hotel, Milwaukee
GENERAL MEETING

MARCH 15
QUAD CITY
Fort Armstrong Hotel, Rock Island
N. J. DUNBECK
Eastern Clay Products, Inc.
Chemically Bonded Molding Sand

MARCH 22
NORTHWESTERN PENNSYLVANIA
Moose Club, Erie
O. J. MYERS
Werner G. Smith Co., Div. of Archer-Daniels-Midland Co.
Core Sands and Binders



Candid camera shots at the Central New York Christmas party.

at the Spring Lake Country Club. Attendance was limited to members and their wives and a total of 80 couples were present. Following the dinner the entertainment featured a floor show and dancing.

Speaker at the November meeting was R. G. McElwee, Vanadium Corp., Detroit, who spoke on "Gray Iron Metallurgy and Foundry Practice." The group met at the Schuler Hotel, Grand Haven, Mich.

St. Louis District

P. C. Schwarz
National Bearing Div.
Publicity Chairman

A CAPACITY crowd turned out for the annual Christmas party of the chapter held December 11 at the York Hotel, St. Louis. Five acts of vaudeville and banquet was the attraction.

Central New York

J. A. Feola
Crouse-Hinds Co.
Publicity Chairman

A HEARTY welcome was extended to the 300 members and guests by Chapter Chairman R. A. Minnear, Ingersoll-Rand Co., Painted Post, who attended the seventh annual Christmas party held at the Onondaga Hotel, Syracuse, December 13.

This was the largest group to attend any chapter activity since the chapter's founding. Long distance honors went to a delegation from Galeton, Pa.

E. Canada & Newfoundland

H. E. Francis
Jenkins Bros. Ltd.
Publicity Chairman

A LARGE turnout of local foundrymen attending the chapter's "Motion Picture Night," featured the December 12 meeting held at the Mount Royal Hotel, Montreal. Two films on fundamentals of bench molding and job molding were shown.

Chapter Chairman A. E. Cartwright, Crane, Ltd., Montreal, was the presiding officer.

Tri-State

F. E. Fogg
Acme Foundry & Machine Co.
Chapter Reporter

THE DECEMBER 19 meeting of the chapter was held at Densmore Cafe, Tulsa, Oklahoma. Speaker was L. P. Robinson, Werner G. Smith Co., Cleveland, and his discussion of core-room problems was highly regarded. Chapter Chairman R. W. Trimble, Bethlehem Supply Co., Tulsa, presided.

New England

Merton A. Hosmer
Hunt-Spiller Mfg. Co.
Association Reporter

THE REGULAR monthly meeting of the New England Foundrymen's Association was held on December 10 at the Engineer's Club, Boston, with an attendance of over 100 members and guests.

National A.F.A. Director and Chicago chapter treasurer B. L. Simpson, president, National Engineering Co., Chicago, was the guest speaker and his subject "Mechanization as an Aid to Labor Relations" was well received.

Mr. Simpson showed some diagrams taken from the results of a questionnaire sent to a group of university seniors. He called attention to the fact that only six per cent of the group preferred foundry work. Some of the reasons for not desiring to work in the foundry were dirt, noise, dust, smoke and general disorder. They also spoke about the general lack of safety and the low

caliber type of worker often found in this industry.

One of the principle advantages given for working in a foundry was the apparent apportunity for improvement which seems to be current in the industry.

Fear Losing Jobs

On the subject of mechanization, the speaker said that the general opinion of men working in plants did not desire mechanization because of fear of losing a job and reduction in salary or the fear of working on machines. The speaker went on to say that machines did not decrease employment and that there is no such thing as "labor saving" but it is rather "labor servicing" which leads to better earnings and more jobs.

Northwestern Pennsylvania

Earl M. Strick
Erie Malleable Iron Co.
Chapter Reporter

ON DECEMBER 22 the chapter held its third annual Christmas party in the Moose Club, Erie. Attending this affair were 165 members and guests. The evening was spent in eating, group singing and enjoying a floor show. Chapter Chairman J. W. Clarke, General Electric Co., Erie acted as toastmaster.

Western New York Chapter Chairman Elliott R. Jones, Lumen Bearing Co., Buffalo; and Chapter Director Leonard Greenfield, Samuel Greenfield Co., Buffalo, were guests of the chapter.

Central New York

J. A. Feola
Crouse-Hinds Co.
Publicity Chairman

CHAPTER CHAIRMAN R. A. Minnear, Ingersoll-Rand Co., Painted Post, N.Y., presided at the January 9 meeting held at the Onondaga Hotel, Syracuse. The program attracted 110 members and guests as this was a sectional meeting. Round table discussions were held on gray iron, malleable and non-ferrous subjects.

Two of the many groups who took part in the Northwestern Pennsylvania chapter's Christmas party.

James O. Ochsner, Crouse-Hinds Co., conducted the gray iron session,

(Left to right) Dave Wuerthle, W. B. George and E. G. White contributed talks to the malleable, non-ferrous and gray iron groups, respectively.

assisted by a panel composed of Marshall B. Dewey, Cayuga Cordage Co.,general foundry practice; Lionel Werner, Crouse-Hinds Co., pattern equipment and gating; and Adam Mahonske, Elmira Foundry Co., Elmira, cupola operation.

This group also heard three short talks: Mr. Ochsner on the transition of foundry operations from an art to a science; Mr. Mahonske an "The Use of Anthracite in the Cupola"; and E. G. White, Crouse-Hinds Co., on "Liquid Propane Fuel for the Core Room."

Dave Wuerthle, A. P. Green Fire Brick Co., presided at the discussions of the malleable section. Chief topics of comment were the values of the various annealing methods and the proper selection of insulating materials.

W. B. George, R. Lavin & Sons, Chicago, handled the non-ferrous table and presented a chart showing an approved method of figuring cost per pound of brass and bronze castings for jobbing foundries. The discussion period covered casting defects, furnace operations, pouring temperatures and gating.

Chicago Non-Ferrous

James Wolfe, Secretary
Non-Ferrous Founders Society

AT A MEETING held January 8 at the Machinery Club of Chicago, James Crosser, Jr., chief engineer, industrial hygiene unit, division of

The gray iron men who participated in Central New York's sectional meeting (starting left) M. B. Dewey, J. O. Ochsner, Adam Mahonske and Lionel Werner.

factory inspection, Department of Labor, State of Illinois, spoke on the subject, "What We Expect of Non-Ferrous Foundries Relative to Health and Safety."

The speaker explained functions of his department and told those present that they were always welcome to call the department for information and assistance. He pointed out that the department offers a free service in examining blueprints of exhaust systems and any other planned installation.

New officers elected for 1948 included J. K. Hodgson, Hodgson Foundry Co., *Chairman;* Charles Leitelt, Leitelt Bros., Inc., *Vice-Chairman;* and H. A. White, Smeeth Harwood Co., *Secretary,* all of Chicago.

Central Indiana

W. K. Mitchell
L. W. & W. K. Mitchell Co.
Chapter Reporter

APPROXIMATELY ONE hundred foundrymen attending the January 5 chapter meeting heard an address on "A Progress Report on Plastic Bonded Molding Sands" by E. W. Claar, Eastern Clay Products, Inc., Jackson, Ohio.

The speaker reviewed the progress in developing plastic bonded sands and outlined the goals expected to be reached in coming months through the use of this practice. Mr. Claar pointed out that the recent perfection of a dry powder plastic material, to replace the original liquid plastic has improved the mulling and mixing properties of the sand grain coating.

Mr. Claar itemized the advantages of plastic coated sands as follows: (1) rapid mixing; (2) low water; (3) low clay; (4) higher permeability; (5) higher flowability; (6) good workability; (7) cleaner; (8) easy shakeout; and (9) rapid cleanning and finishing of castings.

Castings have been made from one to 4,000 lb. using plastic bonded

Canton District chapter recently honored the regional Old Timers by holding a meeting in their honor. Those accorded recognition were (sitting, starting left) O. A. Baechle; Tom Betz; George Hunter; E. F. Krauss; James McCreamor; John Boyle; Ed Fletcher; Harry Towns; Burt McCullick and William Devine. Back row, starting left—C. A. Jackson, E. F. Kipp; W. S. Renzenbrink; W. S. Johnston; Harry Wisener; John Bonnot; Charles Geiger; Frank Ackleson and Sam Rinier.

sand with marked reductions in scrap loss and cleaning time, the speaker remarked in closing.

S. F. Swain, Golden Foundry, Columbus, Ind., served as technical chairman for the meeting.

Central Michigan

Fitz Coghlin, Jr.
Albion Malleable Iron Co.
Secretary-Treasurer

A LARGE GROUP of members and guests attended the chapter's first Christmas dinner-dance on December 19 at the Riverside Country Club, Battle Creek. Chapter Chairman Douglas J. Strong, Foundries Materials Co., Coldwater, welcomed the group and Fitz Coghlin, Jr., gave a brief resume of the organization and purpose of the A.F.A. as well as the growth of the local group.

The rest of the evening was devoted to dancing and singing.

Metropolitan

W. H. Ferguson
Electro Metallurgical Sales Corp.
Chapter Reporter

OFFICERS, MEMBERS and guests of the chapter were addressed by Harry H. Kessler, manager foundry operations, Sorbo-Mat Process Engineers, St. Louis, at the January 5 meeting. He delivered a talk on "The Gating and Risering of Iron Castings."

Mr. Kessler explained in detail various methods employed for the proper gating and risering of many

(Continued on Page 91)

At the December 11 meeting of the Canton District chapter (reported in January, AMERICAN FOUNDRYMAN, p. 89) R. L. Lee, General Motors Corp., Detroit, was the principal speaker. Others who took part in this meeting were (sitting, starting left) Chapter Secretary J. L. Dickerson and Chapter Chairman C. F. Bunting, Pitcairn Co., Barberton, Ohio; and Chapter Vice-Chairman E. H. Taylor, F. E. Myers & Bros. Co., Ashland. Back row (starting left) Past Chapter Chairman K. F. Schmidt, United Engineering & Foundry Co., Canton; Mr. Lee; Charles McLaughlin, Lectro-Melt Casting Co., Barberton; Past Chairman I. M. Emery, Massillon Steel Castings Co.

Part of the 400 members and guests at the Twin City chapter's Christmas party held December 12 at the Raddisson Hotel, Minneapolis.

(Photos courtesy Pufahl Foundry Co.)

★ FEBRUARY WHO'S WHO ★

J. G. Pearce

J. G. Pearce, director, British Cast Iron Research Association, Birmingham, England, is a graduate of the University of Birmingham . . . Upon graduating he served his engineering apprenticeship with the British Westinghouse Co. Ltd. (later became the Metropolitan-Vickers Electrical Co. Ltd.) . . . Became associated with Sir Arthur Fleming, while at Westinghouse, and aided in establishing the company's research and education department . . . Visited the United States during this period as liaison engineer to the Westinghouse companies . . . In 1925 obtained the appointment as director, BCIRA . . . Is a member of many scientific and technical societies and has presented many papers to various institutions . . . He was largely responsible for the establishment of the Association of Special Libraries and Information Bureau and the National Foundry College.

R. G. Wagner

Richard G. Wagner was born in LaConner, Wash. . . . Started his engineering career as a machinist patternmaker in the shops of the Great Northern Railroad, Seattle . . . Two years later joined the Sumner Iron Works, Everett, Wash., as apprentice patternmaker . . . Entered State Normal School of Washington to acquire a teaching certificate and during the summers worked in various jobbing foundries in Seattle . . . In 1925 became associated with Puget Sound Naval Shipyard as a patternmaker . . . Has taken a keen interest in apprentice training and adapting plastics to patternmaking . . . Is training supervisor in the pattern shop and was later elevated to quarterman patternmaker . . . One of the duties assigned to Mr. Wagner was the preparation of a patternmakers manual for training and reference purposes . . . A section of this manual is published in this issue and Mr. Wagner's co-author was E. J. McAfee . . . Has continued his interest in the development of plastics as applied to foundry and pattern work. . . Recently organized The Plastic Pattern Engineers, a technical group, in Seattle.

David Tamor

From the world's largest city comes David Tamor . . . A metallurgical engineer, he obtained his Bachelor of Science degree from Carnegie Institute of Technology, Pittsburgh, Pa. (1921) . . . Upon graduating became associated with Minas de Matahambre, Pina Del Rio, Cuba, and held the positions of mine surveyor, mine statistician and assistant mill superintendent . . . Two years later (1923) joined U. S. Metals Refining Co., Carteret, N.J., as metallurgical assistant . . . In 1925 was named plant metallurgist, American Chain & Cable Co., Inc., Hartford, Conn. . . . Was transferred to the York, Pa., plant in 1940 and assumed the position of plant metallurgist, malleable foundry . . . Has spoken before a number of A.F.A. chapters and other technical groups on such topics as foundry sand practice and incipient shrinkage of red brasses . . . Is a past chairman of the A.F.A. Chesapeake chapter and the Connecticut Non-Ferrous Foundrymen's Association . . . Is currently serving as director, Chesapeake chapter . . . Member of A.F.A. and ASM.

H. J. Rowe

H. J. Rowe, co-author with T. R. Gauthier of the article on aluminum foundry practice published herein, was born in Cleveland . . . Mr. Rowe is a graduate of Case Institute of Technology, Cleveland, receiving his Bachelor of Science degree in 1927 . . . Upon finishing college he joined the Aluminum Company of America, Cleveland . . . In 1944 he was transferred to the Pittsburgh, Pa., plant and is chief metallurgist, castings division . . . Has contributed much to both the technical press and societies on aluminum casting subjects . . . A member of the A.F.A. Aluminum & Magnesium Division, he serves on the following committees: Program and Papers, Sand Casting, Test Bar, Book Review, and Centrifugal Casting . . . He is also chairman of the division's Alloy Recommendation Committee . . . A member of A.F.A., ASM and ASTM.

T. R. Gauthier

Waterloo, Iowa, is the birthplace of T. R. Gauthier . . . He attended and graduated from Iowa State College, Ames . . . Obtained his Bachelor of Science degree in chemical engineering in 1940 . . . Joined the Aluminum Company of America, Cleveland, following his graduation and was appointed metallurgical engineer . . . Was transferred in 1946 to the Pittsburgh, Pa., plant and maintained his prevous title . . . Mr. Gauthier is co-author with H. J. Rowe of the article published in this issue on engineering of aluminum alloy castings.

R. L. Lee

A frequent contributor to AMERICAN FOUNDRYMAN, Ralph L. Lee is as well-known as an author as he is a chapter speaker . . . At present he is a member of the employee cooperation staff, General Motors Corp., Detroit . . . He has been associated with General Motors for twenty-three years . . . Began his industrial career with Delco Light Co., Dayton, Ohio, which later became the Frigidaire and Delco Products Division of GMC . . . Advanced to assistant sales manager for Frigidaire before transferring to Detroit as assistant director of consumer research . . . Later joined the staff of vice-president in charge of sales before moving to his present position . . . Member of A.F.A.

E. J. McAfee

From *The Patternmaker's Manual* prepared by Messrs. McAfee and R. G. Wagner, Puget Sound Naval Shipyard, Puget Sound, Wash., comes an article on pattern practice . . . Mr. McAfee is known to readers of AMERICAN FOUNDRYMAN as in July, 1947, his paper on *Making Plastic Patterns* was published . . .The co-author descends from a family of foundrymen . . . Most of the members being molders . . . Mr. McAfee turned to the patternmaking trade and was an apprentice in Portland, Oregon . . . Prior to World War I he became associated with the Puget Sound Naval Shipyard as a patternmaker and has remained with this naval base . . . In 1938 he received the appointment as master patternmaker . . . He is a member of A.F.A.

H. C. Frisbie

Synthetic resin core binders is the subject of Mr. Frisbie's article which is published herein . . . A native of Cleveland . . . Has been field product development engineer in New England for the Lubri-Zul Corp. . . . Recently joined the sales staff of E. F. Houghton & Co., Philadelphia, as foundry service engineer . . . Has spoken at chapter meetings of the New England Foundrymen's Association as well as at that organization's regional conference . . . A member of the A.F.A. he is active in its Metropolitan chapter and also the ASLE.

W. T. Shute

Pressure Feeding of Steel Castings is published in this issue of AMERICAN FOUNDRYMAN and was written by W. Turney Shute . . . The author is general foundry foreman, steel foundry division, Canadian Car & Foundry Co., Ltd., Montreal, Quebec, Canada . . . Is a graduate of McGill University, Montreal, having obtained his degree in 1934 . . . Joined Canadian Car & Foundry Co., Ltd., in 1939, where he has served continously except for two years when he was a member of Canada's armed forces . . . As a member of the American Foundrymen's Association, Mr. Shute is affiliated with the Eastern Canada and Newfoundland chapter . . . Active in this organization he serves as a chapter director and also as vice-chairman of the chapter's educational committee . . . Author of various technical papers he has been a frequent speaker at two of the Canadian chapters—Eastern Canada and Ontario.

A.F.A. CHAPTER DIRECTORY

BIRMINGHAM DISTRICT CHAPTER
Secretary- Treasurer, F. K. Brown, Adams, Rowe & Norman, Inc.

BRITISH COLUMBIA CHAPTER
Secretary-Treasurer, L. P. Young, A-1 Steel & Iron Foundry Ltd.

CANTON DISTRICT CHAPTER
Secretary, J. L. Dickerson, Pitcairn Co., Barberton.

CENTRAL ILLINOIS CHAPTER
Secretary- Treasurer, G. H. Rockwell, Caterpillar Tractor Co.

CENTRAL INDIANA CHAPTER
Secretary, Jack Giddens, International Harvester Co.

CENTRAL MICHIGAN CHAPTER
Secretary-Treasurer, Fitz Coghlin, Jr., Albion Malleable Iron Co.

CENTRAL NEW YORK CHAPTER
Secretary, J. F. Livingston, Crouse- Hinds Co.

CENTRAL OHIO CHAPTER
Secretary, D. E. Krause, Battelle Memorial Institute.

CHESAPEAKE CHAPTER
Secretary-Treasurer, L. H. Denton, Baltimore Convention Bureau.

CHICAGO CHAPTER
Secretary, V. M. Rowell, Velsicol Corp.

CINCINNATI DISTRICT CHAPTER
Secretary, E. F. Kindinger, Williams & Co., Inc.

DETROIT CHAPTER
Secretary, R. E. Cleland, Eastern Clay Products Inc.

EASTERN CANADA AND NEWFOUNDLAND CHAPTER
Secretary, J. G. Hunt, Dominion Engineering Works Ltd.

EASTERN NEW YORK CHAPTER
Secretary-Treasurer, J. A. Wettergreen, General Electric Co.

METROPOLITAN CHAPTER
Secretary, J. F. Bauer, Hickman, Williams & Co.

MEXICO CITY CHAPTER
Secretary, N. S. Covacevich, Casa Covacevich

MICHIANA CHAPTER
Secretary- Treasurer, V. S. Spears, American Wheelabrator & Equip. Co.

NORTHEASTERN OHIO CHAPTER
Secretary, R. D. Walters, Werner G. Smith Co.

NORTHERN CALIFORNIA CHAPTER
Secretary, J. F. Aicher, E. A. Wilcox Co.

NORTHERN ILLINOIS-SOUTHERN WISCONSIN
Secretary, L. C. Fill, Geo. D. Roper Corp.

NORTHWESTERN PENNSYLVANIA CHAPTER
Secretary, H. L. Gebhardt, United Oil Mfg. Co.

ONTARIO CHAPTER
Secretary-Treasurer, G. L. White, Westman Publications Ltd.

OREGON CHAPTER
Secretary-Treasurer, A. B. Holmes, Crawford & Doherty Fdry. Co.

PHILADELPHIA CHAPTER
Secretary-Treasurer, W. B. Coleman, W. B. Coleman & Co.

QUAD CITY CHAPTER
Secretary-Treasurer, C. R. Marthens, Marthens Co.

ROCHESTER CHAPTER
Secretary-Treasurer. L. C. Kimpal, Rochester Gas & Electric Corp.

SAGINAW VALLEY CHAPTER
Secretary-Treasurer, L. L. Clark, General Motors Corp.

ST. LOUIS DISTRICT CHAPTER
Secretary, P. E. Retzlaff, Bush-Sulzer Bros.-Diesel Engrg. Co.

SOUTHERN CALIFORNIA CHAPTER
Secretary, J. E. Wilson, Climax Molybdenum Co.

TEXAS CHAPTER
Secretary-Treasurer, H. L. Wren.

TIMBERLINE CHAPTER
Secretary, C. E. Stull, Manufacturers Foundry Corp.

TOLEDO CHAPTER
Secretary-Treasurer, R. H. Van Hellen, Unitcast Corp.

TRI-STATE CHAPTER
Secretary, C. B. Fisher, Enardo Foundry & Mfg. Co.

TWIN CITY CHAPTER
Secretary-Treasurer, L. K. Polzin, Minneapolis Chamber of Commerce.

WASHINGTON CHAPTER
Secretary-Treasurer, A. D. Cummings, Western Foundry Sand Co.

WESTERN MICHIGAN CHAPTER
Secretary, D. A. Paull, Sealed Power Corp.

WESTERN NEW YORK CHAPTER
Secretary, F. L. Weaver, Weaver Materiel Service.

WISCONSIN CHAPTER
Secretary, A. C. Haack, Wisconsin Grey Iron Foundry Co.

STUDENT CHAPTERS

UNIVERSITY OF MINNESOTA *Secretary,* Harvey Saubey

UNIVERSITY OF MISSOURI *Secretary,* Stanley Zirinsky

OHIO STATE UNIVERSITY *Secretary-Treasurer,* Eldon Boner

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Secretary-Treasurer, Martin J. O'Brien

38

4

Scrap Pile or Shipping Room?

Where do most of your castings end up? Shop scrap is mighty fine to re-melt, but isn't it a pleasant feeling to look yours over and note that it's practically 100% gates and sprues? Let Semet-Solvay Foundry Coke and Semet-Solvay metallurgists help keep your rejects down and your profits up. They can do it!

SEMET-SOLVAY DIVISION
ALLIED CHEMICAL & DYE CORPORATION

BUHL BUILDING, Detroit 26, Mich.
GENESEE BUILDING, Buffalo 2, N. Y.
DIXIE TERMINAL BUILDING, Cincinnati 2, Ohio
Canadian Sales Agent: Standard Fuel Co., Ltd., Toronto

Semet-Solvay Foundry Coke

for Better Melting

HOFFMAN
VACUUM CLEANING EQUIPMENT

Wall and overhead dust that imperils workers' health and filters down to cause defective castings can be effectively removed with Hoffman Vacuum cleaning. Cleans molds, cores, and intricate castings faster and better and at a big saving — eliminates compressed air and hazardous blowing methods ← (see cut) Portable units or stationary systems built for lifetime, heavy-duty service.

LET US SEND YOU THE FACTS ON WHAT OTHER PLANTS ARE DOING

U. S. HOFFMAN MACHINERY CORPORATION
AIR APPLIANCE DIVISION, 99 FOURTH AVE., NEW YORK 3, N.Y.

PERSONALITIES

(*Continued from Page 68*)

Harold Von Thaden, who joined Robins Conveyors 25 years ago, heads the new Hewitt-Robins, Inc., division, Robins Engineers. **Elmer C. Salzman** will be vice-president in charge of sales, and **R. W. Eichenberger,** will be vice-president in charge of the middlewest office located in Chicago. This new division has been organized to handle the contracting phases in the design, engineering and installation of complete material handling and processing plants.

Donald O. Notman, who has been director, technical division, Electrochemicals Department, Du Pont Co., Wilmington, Del., is now assistant general manager. He succeeds Samuel G. Baker who became general manager with the retirement of **F. S. MacGregor,** who was with the firm for more than 30 years.

Dr. E. A. Harding, who has been director of production, becomes director, technical division. **Russell L. Hardy,** manager, Niagara Falls, N.Y., plant, becomes director of production, and **Dr. N. C. Jones,** assistant manager of the plant.

Three men who aided in founding the Hyde Park Foundry & Machine Co., New Kensington, Pa., more than a half century ago and managed it without interruption for 52 years have resigned their posts. The officials are: **Thomas W. McCausland,** president; **James Lees,** vice-president; and **N. H. Slonaker,** secretary and treasurer.

They will be replaced by **Charles T. Slonaker,** son of N. H. Slonaker, as chairman of the board and president; **Edward M. McCausland,** son of T. W. McCausland, as vice-president; and **G. E. Clifton,** as secretary and treasurer. Mr. Slonaker will also be general manager and Mr. McCausland assistant general manager.

Joseph F. Eckel has been promoted to manager of the General Electric Company's Lynn River Works. Mr. Eckel, assistant manager since April, 1945, succeeds George M. Stevens who retired after 46 years of service.

Frank R. Milliken has been named plant manager, National Lead Company's MacIntyre development, titanium division, Tahawus, N.Y. Mr. Milliken, who has been assistant manager, succeeds **Floyd M. Wiles. Allan R. Riser,** general superintendent, replaces Mr. Milliken.

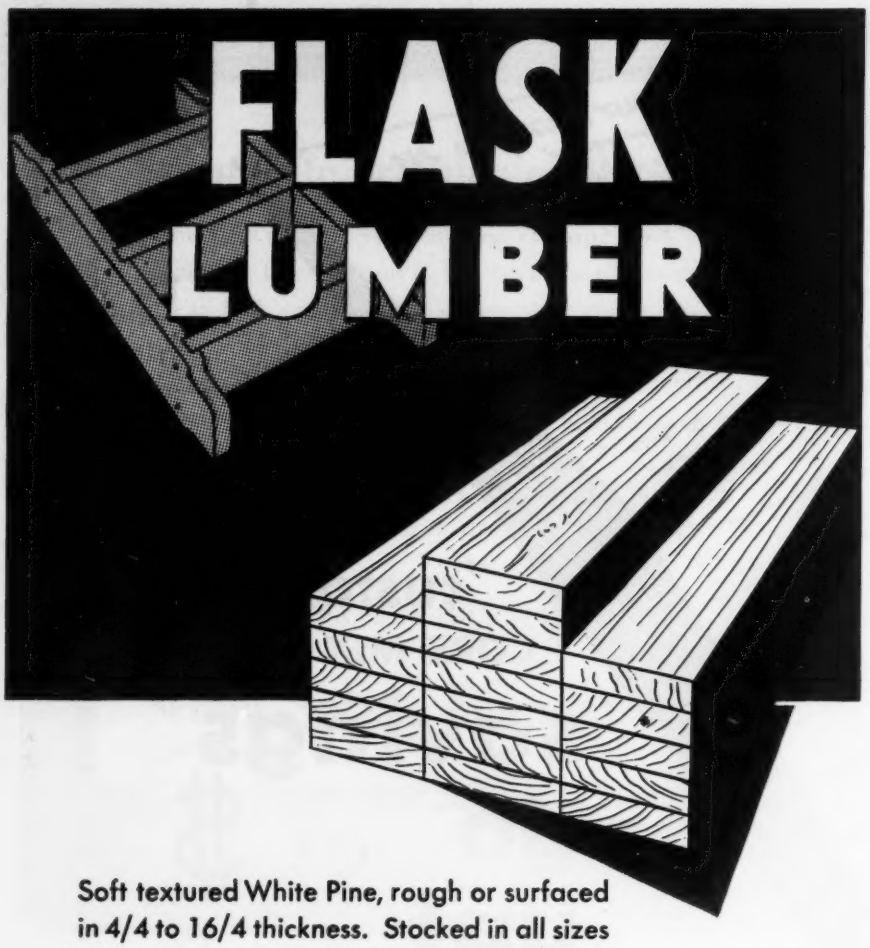
The new plant manager is a graduate of MIT and has been at Tahawus since 1941.

R. H. Hays, metallographer, Caterpillar Tractor Co., Peoria, Ill., recently won the grand prize in the ASM Metallographic Exhibit held during the National Metal Exposition.

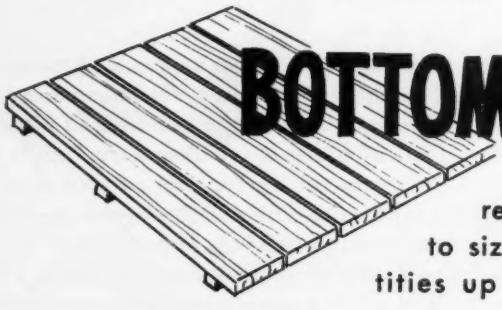
Acme Aluminum Alloys, Dayton, Ohio, announce these changes in their executive personnel: **Russell Coblentz,** manager, Acme Tool Division; **Albert Fisher,** super-

(*Continued on Page 82*)

SWAN-FINCH CASE HISTORY No. 258
(name on request)
Products:
Iron, Steel, Brass Castings
Core size range: 2 oz. to 3000 lb.
Typical Core Mix:
70 qt. 40 Jersey Silica Sand
1½ qt. Safco 3-159 Core Oil
½ qt. Tykor
6 qt. Silica Flour
7½ qt. Water
Advantages:
Using a binder mix of Tykor and Safco 3-159, cores baked out more rapidly, collapsibility was improved, smoother casting surfaces were produced.
Extra Benefits:
Stronger cores of high surface hardness... no "burning in"... no metal penetration... less time required for cleaning castings... core production improved.
"custom-made"
CORE MIX USED...
savings go up!
...CASTINGS ARE IMPROVED
Again a Swan-Finch Engineer's report reads: "Customer very much pleased." Outstanding results like those listed prompt such comments. A core binder change might well add your foundry to the hundreds of others benefiting from a switch to Swan-Finch binders. Give them a try. Call in a Swan-Finch Engineer. Let him set up core binder tests on your work. His comprehensive experience with foundry operations and binder properties may point the way to important savings in production costs. The Swan-Finch Engineer is backed by Swan-Finch's 95 years of successful service in supplying specially compounded core binders, cutting compounds and maintenance lubricants for industrial applications... Call in a Swan-Finch Engineer. There will be no interruption of your production, no obligation involved. Send also for your copies of new Swan-Finch Core Binder Bulletins.
Reg. U. S. Pat. Off.
SWAN-FINCH OIL CORPORATION
CHICAGO • DETROIT • NEW YORK



Soft textured White Pine, rough or surfaced in 4/4 to 16/4 thickness. Stocked in all sizes or cut to your individual specifications.



BOTTOMBOARDS

Complete to your requirements or cut to size lumber in quantities up to full carloads.

CRATING • PATTERN LUMBER • WEDGES
SKIDS • FOUNDRY MALLETS • BENCH LUMBER
BENCHES • PLYWOOD • HARDBOARD • DOWELS

DOUGHERTY LUMBER CO.

CLEVELAND 5, OHIO

YOUNGSTOWN, OHIO
PITTSBURGH, PA.

DIAMOND 1200

WILLOW RANCH, CALIF.
LAKEVIEW, OREGON

PERSONALITIES

(Continued from Page 80)

intendent of the foundry division; **Charles Lachey,** superintendent of the pattern division; **Thomas Kramer,** chief metallurgist; **Melvin Conwell,** chief inspector; and **Robert Hoffman,** in charge of experimental engineering and development.

Norman P. Robie has joined the research staff, Electro Refractories & Alloys Corp., Buffalo, N.Y., where he has been appointed engineer-in-charge of organic and abrasive research. Formerly with the National Bureau of Standards, he has more recently been senior research engineer in the laboratories of the Carborundum Company.

Vincent D. Barth has joined Battelle Memorial Institute, Columbus, Ohio, to conduct research in non-ferrous metallurgy, his more recent previous connections having been with Federated Metals Div. and Douglas Aircraft Corp. **Joseph Gurland** is also now connected with Battelle to engage in the same enterprise, holding a master's degree in chemical engineering and metallurgy from New York University. **Harold W. Herring,** mechanical engineer, is a new member, engaged in research on production materials and methods, having been design engineer for the Curtiss-Wright Corp.

Robert E. Busey has been appointed assistant chief engineer, Willys-Overland Motors, Toledo, Ohio. Mr. Busey, former executive engineer, White Motor Co., will serve as direct assistant to the chief engineer.

T. W. MacLean, formerly with Lava Crucible Co., Pittsburgh, has been appointed sales representative, Western Metal Co., Chicago. Mr. MacLean will cover Indiana, Kentucky and Southern Illinois.

Dr. Linus C. Pauling, chairman of the division of chemistry and chemical engineering, California Institute of Technology, Los Angeles, and one of the world's leading theoretical chemists, has been elected president of the American Chemical Society for 1949. Dr. Pauling assumed his office as president-elect in January.

Charles Edward Lucke, professor emeritus of mechanical engineering, Columbia University, New York, was recently honored at the ASME Annual Meeting held in Atlantic City for originating the idea of divisions in technical societies.

Central Illinois Chapter Chairman **A. V. Marthens,** president, Pekin Foundry Co., Pekin, Ill., has been elected to the administrative council, National Founders Association, Chicago.

Charles W. Pfeiffer, foundry superintendent, F. L. Heughes & Co., Rochester, N.Y., was recently named first president of the company's newly formed 25 Year Club. In recognition of his more than 56

years of service with the company he was given a gold 50-year pin by Benjamin A. Heughes, president of the company.

Obituaries

Charles W. Bredenfoerder, Jr., 61 years old, a founder of the Southern Ohio Iron Works Co. which ceased operations a few years ago, died recently. In recent years he had been district sales representative in Cincinnati for the Burger Iron Works Co., Dayton, Ohio.

Henry A. Kelley, employed by City Pattern Foundry & Machine Co., Detroit, since 1924, died December 16. He was employed as sales manager.

Harry A. Klaine, 74 years old, president, F. A. Klaine, Cincinnati, died recently.

John M. Felt, 75, one time assistant superintendent, New York Air Brake Co., Watertown, N.Y., died recently. He was formerly general manager of the Ingersoll-Rand Company at Athens, Pa.

Frederick P. Huston, engineer and metallurgist in the development and research division, International Nickel Co., Inc., New York, died December 29. Mr. Huston was in charge of developments in the application of nickel alloys in the railroad field. He had been with the company for more than 20 years.

Charles Donath, founder and president, Phoenix Brass Fittings Corp., died recently. He was 64.

C. H. "Charlie" Clauser, Lehigh Safety Shoe Co., Allentown, Pa., died December 6 at the age of 73. Associated with the company for 25 years he was affectionately known to industry as the "grand old man of safety shoes."

Charles H. Newcomb, an executive of the Rodgers Brown-Lavino Co., Phildelphia, died December 19. A member of the Philadelphia Foundrymen's Association, he was instrumental in founding the A.F.A. Philadelphia chapter and one of its early leaders. He had been in the pig iron business all his life starting with the Phoenix Iron Co.

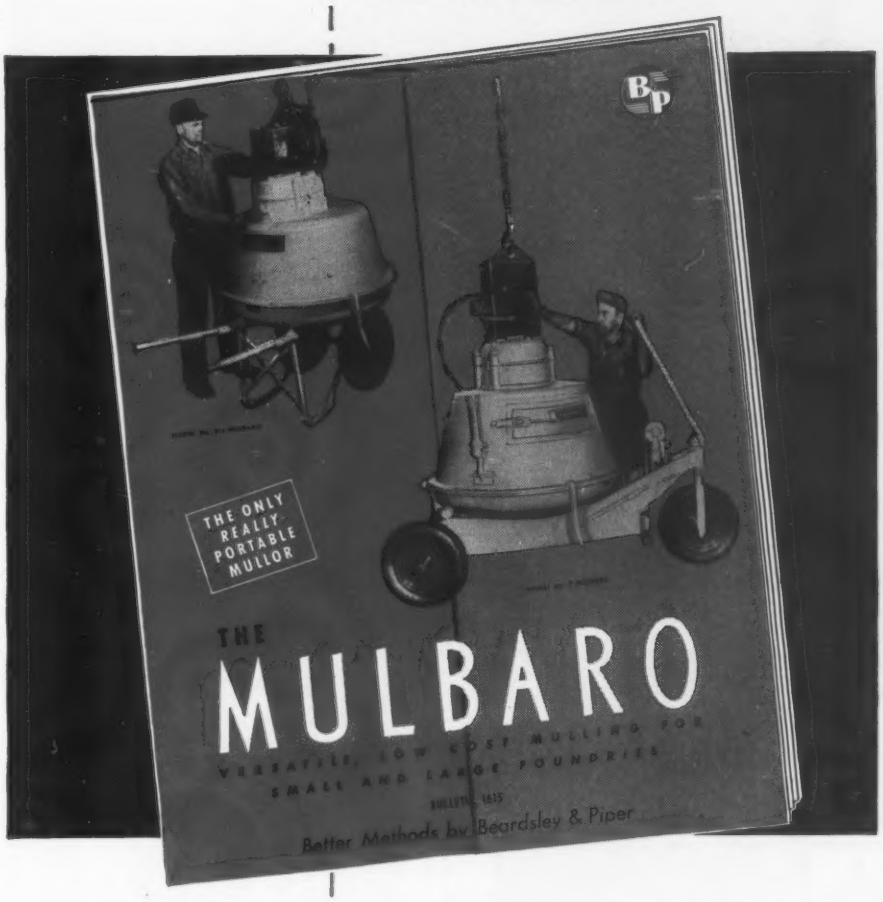
Mr. Newcomb was a champion marksman as he was world's champion in 1910, National champion in 1915 and American amateur champion in 1913 and 1917.

William B. Simpson, 72, chairman, A. M. Castle & Co., Chicago, died January 13. A member of the organization since 1901, he was president in 1908 and chairman in 1930.

Allen F. Edwards, 71, a member of the board, Chrysler Corp., Detroit, and president, Universal Products Co., Inc., died January 13.

GET THIS NEW

MULBARO CATALOG



The Mulbaro is a product of Beardsley & Piper, manufacturers of the Sandslinger • Speedslinger • Speedmullor • Screenarator • Plate Feeder • Sand Conditioning Machine • Champion Speed-Draw • Turn Table.

A new Mulbaro catalog . . . completely describes the advantages and operation of the Mulbaro . . . a versatile, low cost, portable mullor for small and large foundries. Easy to operate—just plug in and push the button! Fast and thorough in mulling, the Mulbaro is the only really portable mullor and is outstanding in flexibility, low initial cost and economy in operation. Be sure to send for your catalog now!

Send Coupon Now!

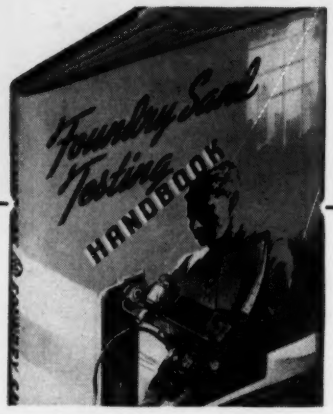
BEARDSLEY & PIPER
Division of Pettibone Mulliken Corp.,
2424 North Cicero Ave., Chicago 39, Illinois
Send me the new Mulbaro Catalog!

FOUNDRY_____
ATTENTION_____
TITLE_____
ADDRESS_____
CITY_____ ZONE____ STATE_____
A

Quantity
PRODUCTION
of
GREY IRON CASTINGS

ONE OF THE NATION'S
LARGEST AND MOST MODERN
PRODUCTION FOUNDRIES

ESTABLISHED 1866
THE WHELAND COMPANY
FOUNDRY DIVISION
MAIN OFFICE AND MANUFACTURING PLANTS
CHATTANOOGA 2, TENNESSEE

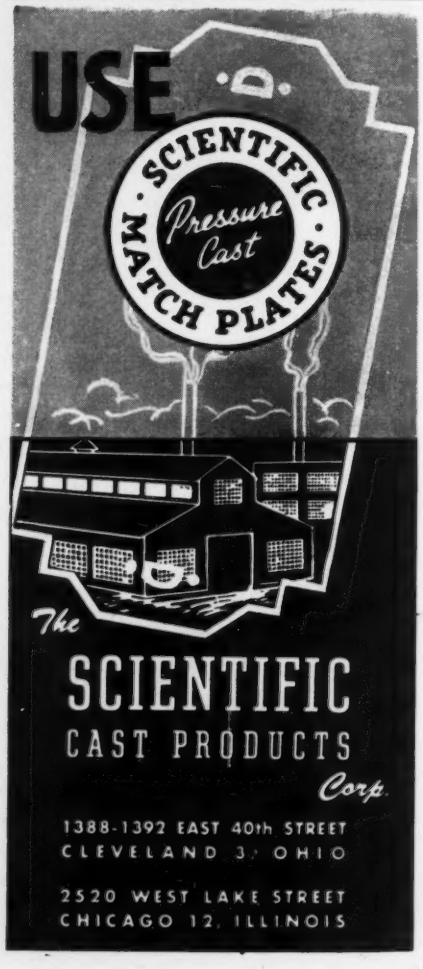


Foundry Sand Testing
HANDBOOK

A foundryman may select his scrap with the greatest of care. His melting procedure may check with the most advanced practice. And he may exercise full control over his methods. BUT . . . he cannot consistently produce sand castings in molds prepared from uncontrolled sand mixtures.

A casting is only as good as the mold . . . that's why the A.F.A. FOUNDRY SAND TESTING HANDBOOK is a "must" for the foundryman's library. Order your copy today: $2.25 to A.F.A. Members; $3.50 List Price.

AMERICAN FOUNDRYMEN'S ASSOCIATION
222 W. Adams St., Chicago 6



The SCIENTIFIC CAST PRODUCTS Corp.
1388-1392 EAST 40th STREET
CLEVELAND 3, OHIO
2520 WEST LAKE STREET
CHICAGO 12, ILLINOIS

PLACEMENT

(*Continued from Page 49*)

had been pledged. Since the budget was originally set up, Northwestern University, Evanston, Ill., was added to the five schools cooperating with FEF. The new three-year budget, printed below, calls for nearly $323,000. This reflects the enlarged program as well as the overall increased cost of education.

Total Operating Disbursements	$ 66,999.50
Office Furniture & Equipment	1,200.00
Scholarships	150,050.00
Equipment (Universities)	71,000.00
Installation of Equipment	9,200.00
Instruction	7,000.00
Total prior to August 1, 1947	15,249.07
Additional Campaign Expense	2,000.00
	$322,698.57

To make use of facilities available among sponsoring organizations, a Technical Advisory Committee has been established by FEF. In addition to George K. Dreher, executive director of the Foundation, it includes: S. C. Massari, technical director, American Foundrymen's Association; A. W. Gregg, executive engineer, Whiting Corp., Harvey, Ill., representing the Foundry Equipment Manufacturers Association; George Johnstone, Jr., president, Johnstone Foundries, Inc., Grove City, Pa., representing the Gray Iron Founders' Society, and James H. Lansing, consulting engineer, Malleable Founders' Society. Individual advisory committees for the universities cooperating with FEF are planned but have not yet been organized.

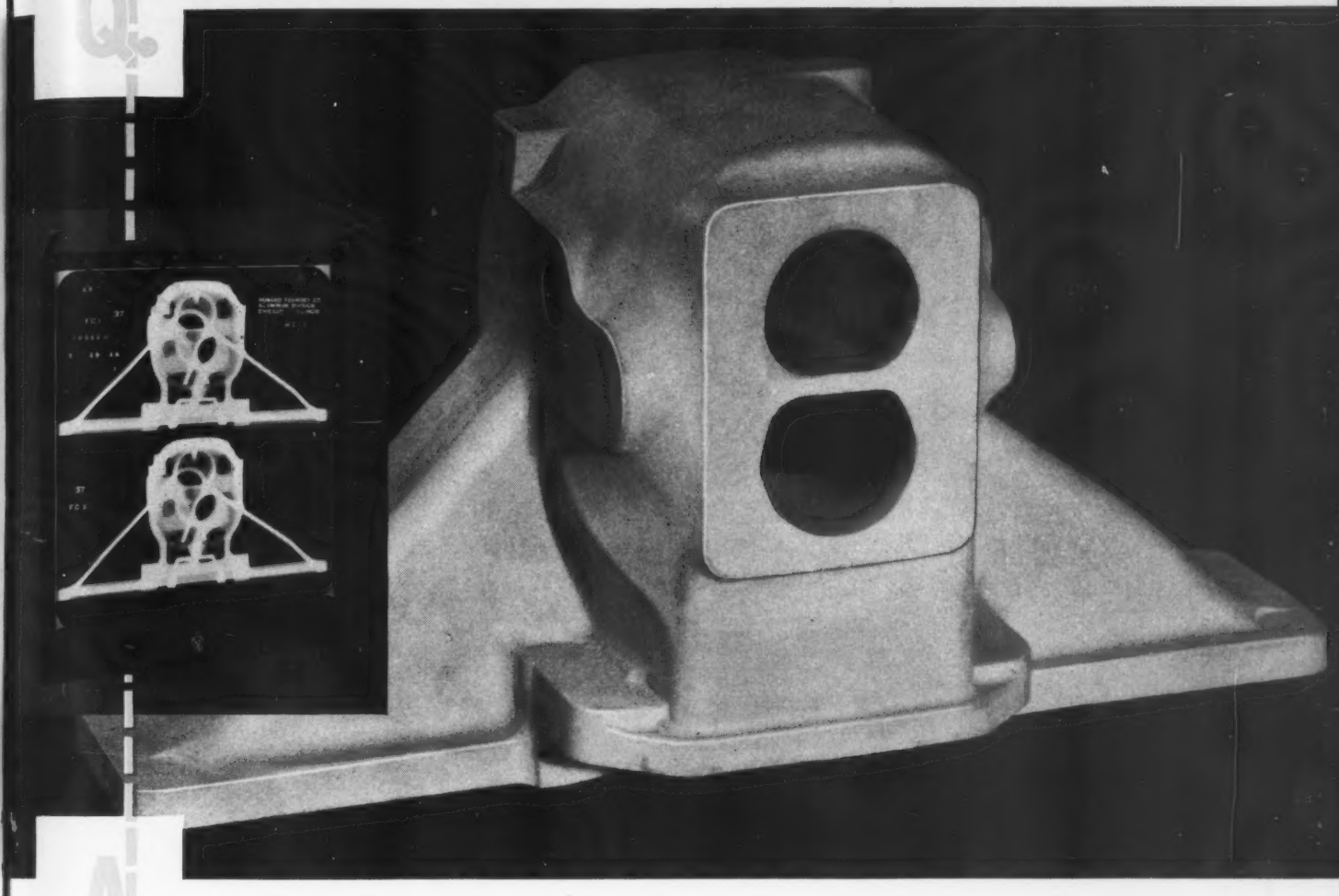
Dutch Bell Foundry In South Carolina

IN WESTERN South Carolina, city of Greenwood, Harry T. Van Bergen, of the 152 year old Van Bergen Bell, Chimes & Carillon Co., Heiligerlee, Netherlands, expects to start production in his bell foundry just as soon as sufficient quantities of tin can be located. The metal used in making bells is approximately 80 per cent copper and the remainder tin.

Mr. Van Bergen came to this country to supervise the installation of a 32-bell carillon in Greenwood before the war. He returned home and brought his wife and son to Greenwood, just in time to escape the German invasion.

Which x-ray film is the first choice for routine 100 kv. radiography of this magnesium casting?

Q.



A.

Kodak's Type A

LIGHT metal castings from this foundry have the reputation for being high-grade . . . because they're radiographed before release.

This radiograph shows just what the customer gets—a casting free of voids, gas holes, porosity, and shrinkage weaknesses, which might otherwise prove costly later on. Kodak Industrial X-ray Film, Type A, was used for the picture.

Why Type A? . . . Because it is well adapted to the short exposure times required by production scheduling. Because it provides the high radiographic sensitivity—extremely high contrast and fine grain—necessary for greatest detail visibility in the critical radiographic inspection of magnesium, aluminum, and their alloys.

Radiography often more than pays for itself. In the foundry, savings not only exceed the cost of x-ray equipment and operations by reductions in customer rejections, but, by nondestructive testing, radiography points the way to more exact casting methods. On the production line, it saves by showing internal defects before expensive machining gets underway—avoiding broken tools, wasted machine time, and delays in production.

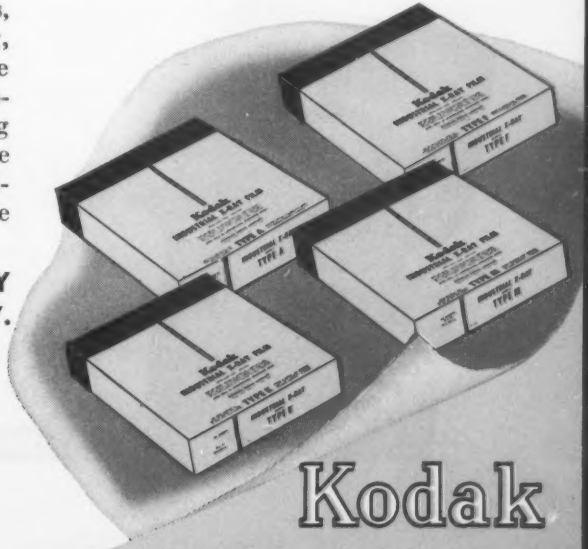
EASTMAN KODAK COMPANY
X-ray Division, Rochester 4, N. Y.

Other Kodak Industrial X-ray Films

Kodak Industrial X-ray Film, Type F . . . with calcium tungstate screens—primarily for radiography of heavy steel parts. The fastest possible radiographic procedure.

Type M . . . first choice in critical inspection of light alloys or in the examination of thin steel at moderate voltages and heavy alloy parts with million-volt equipment.

Kodak Industrial X-ray Film, Type K . . . primarily for gamma- and x-ray radiography of heavy steel parts, or of lighter parts at limited voltages where high film speed is needed.



Radiography

. . . another important function of photography

Kodak

Facts...

- ABOUT INCREASED PRODUCTION
- REDUCED COSTS
- IMPROVED WORKING CONDITIONS
- REDUCED SCRAP
- MODERNIZATION &
- MECHANIZATION IN YOUR FOUNDRY

$ $ c $ $ $

REALLY MEANS DOLLARS AND CENTS TO YOU

$ c

We can supply those facts. We specialize in foundry problems with reference to:

1. COMPLETE FOUNDRY SURVEYS
2. FOUNDRY CONSULTING & DESIGNING
3. ENGINEERED FOUNDRY SYSTEMS

Plus . . . SUPERVISION AND CONTROL

We have applied our services successfully to gray iron, brass, steel malleable, aluminum and magnesium foundries. Case histories available on all cases. Write for new illustrated Bulletin "A."

Engineering service, inc.

610 W. Michigan St., Milwaukee 3, Wisconsin
Phone MArquette 0673.

NO MORE ATHLETE'S FOOT!

The simple Ōnox method of skin-toughening has made Athletes Foot a thing of the past in thousands of leading American plants.

No mess, no splash, no waste. Costs only 1c per man per week—and the men *like* the Ōnox mats. For trial offer, write:

ŌNOX, INC. DEPT. GF, 121-2nd St., San Francisco
WAREHOUSES: BROOKLYN, CLEVELAND, NEW ORLEANS, LOS ANGELES

★ Sharper Castings
★ Greater Brinell Hardness
★ Increase Tensile Strength
★ Increase Transverse Strength
★ Increase Wear Resistance
★ Increase Heat Resistance

Copper Shot

IMPROVES YOUR IRON

ALTER COMPANY Fifty Years of Service
1701 Rockingham Road, Davenport, Iowa

FIRM FACTS

A section of the **Herron Stove & Foundry,** Chattanooga, Tenn., was destroyed by fire recently. Loss could not be estimated.

General Electric X-ray Corporation has moved its main offices, laboratories and manufacturing plant from Chicago to 4855 McGeoch Ave., Milwaukee.

Construction of the **Bel-Foundry, Inc.,** Belvidere, Ill., has been started.

Formation of the **Glenn-McKeon Corp.,** Chicago, to purchase the Elliott Foundry & Machine Works and the Pneumatic Gate Works, has been announced. E. Kevin Glynn is president and James P. McKeon is vice-president.

Koppers Co., Inc., recently purchased the government-owned blast furnace and coke plant at Granite City, Ill.

The King Machine Tool Co., Cincinnati, has been acquired by the **American Steel Foundries.** Business will be conducted as the King Machine Tool Div.

Stone & Webster, Inc., Boston, has acquired E. B. Badger & Sons Co., Boston, for the purpose of expanding their engineering and construction activities.

The Elmira Foundry Co., Inc., Elmira, N.Y., has been made an integral part of the **General Electric Company.** Dissolution of the corporation, heretofore a General Electric affiliated company, became effective January 2. Under the reorganization, the foundry becomes one of the nine major works and 24 factories composing the apparatus department.

Precision castings for special equipment to be used in physics research projects at Washington University, St. Louis, are being cast at the **Mullins Non-Ferrous Castings Corp.,** St. Louis.

Lester B. Knight & Associates, Chicago, has opened a New York office at 30 Church St.

A $200,000 fire recently destroyed a section of the **Acme Aluminum Foundry Co.,** Chicago.

The **Kaiser-Fraser Dowagiac foundry division,** Dowagiac, Mich., is spending $250,000 for new equipment and modernization.

J. I. Case Company has purchased the Anniston, Ala., plant, Kilby Steel Co.

Metalloy Foundry Co., Hudson, Mich., has started operations and is pouring aluminum, brass, manganese and bronze castings. Officers of the company are: Nelson Berlin, president; Charles Gibbons, vice-president; and Richard Berlin, secretary-treasurer.

The **Square Deal Foundry Co.,** Detroit, was damaged recently by fire to the extent of $20,000.

The **Clayton Foundry Co., Inc.,** Wakefield, Mass., incorporated recently with Richard G. Clayton, president; Henry F. Clayton, treasurer; and Mary L. Clayton, clerk.

Harry B. Swan, foundry consultant, Detroit, has moved his office from the Industrial Bank Building to 2983 East Grand Blvd.

..**Sharon Steel Corporation** has bought a large by-products coke plant at Fairmont, West Va. The plant, including 65 ovens with an output capacity of 25,000 tons of coke monthly, was bought from Standard Oil Co. of New Jersey.

The **Apex Smelting Co.,** Chicago, recently purchased the National Smelting Co., Cleveland. The newly acquired establishment will be known as the Apex Smelting Co. Cleveland plant.

The **Attalla Pipe & Foundry Co.,** Tuscaloosa, Ala., has taken over the Gadsden Iron Works, Gadsden, Ala. William B. Neal, former president, Gadsden Iron Works, will be in charge of the Attalla Pipe sales branch as vice-president.

Gerlinger Equipment, Inc., Milwaukee, has been named agents for all Hydro-Blast equipment in the state of Wisconsin and Northern Illinois.

Federated Metals Div., American Smelting & Refining Co., New York, has been licensed to manufacture and sell olympic bronze ingot, a silicon bronze alloy. The rights are owned by Chase Brass & Copper Co.

Western Foundry Co., formerly of San Jose, Calif., is now located at 1850 Grant St., Santa Clara, Calif.

Electric Steel Foundry Co., Danville, Ill., is operating and manufacturing steel buckets for draglines and power shovels.

Shanafelt Mfg. Co., 54-year-old manufacturer of foundry products, has just recently completed the moving of their entire operations to their new plant at 2623 Winfield Way N. E., Canton, Ohio.

The new factory and office building is situated on 6-acres of ground in the northeast section of Canton. It is a thoroughly modern single story building with 35,000 sq. ft. of floor space.

Air **Reduction Sales Co.** has opened a retail store for the sale of welding products at the corner of 10th & Cherry St., Des Moines, Iowa. It will carry a complete local stock of oxygen, acetylene and other industrial gases, carbide, oxyacetylene welding and cutting equipment and supplies and a variety of accessories.

General Bronze Corp. announce the removal of their eastern division to their plant at Stewart Ave., Garden City, Long Island, N. Y.

THE SURE WAY TO GOOD NON-FERROUS CASTINGS IS WITH *Crucible Melting*

High yield of good castings requires proper melting equipment. Crucible melting is the only method of non-ferrous melting which limits the possible contact of molten metal with furnace atmosphere.

The crucible furnace operator has complete control of exposure of the metal during melting. Direct transmission of heat to metal means direct contact of furnace gases with the metal. Avoid this condition with crucible furnaces.

For practical suggestions on melting, ask for "Crucible Melters' Handbook." Mailed free.

90 WEST STREET, NEW YORK 6, NEW YORK

order National brand bentonite

Prompt shipment—unlimited quantities now available to foundries from BAROID—the world's largest producer of bentonite. Our modern plants are geared to fulfill every requirement of the foundry trade.

highest foundry quality

baroid SALES DIVISION
NATIONAL LEAD COMPANY

Bentonite Sales Office
Railway Exchange Building
CHICAGO 4, ILL.

"Founded in 1907"

HYMAN VIENER & SONS

Producers of

VIENER METALS

ALUMINUM — BABBITT — BRASS — BRONZE — DIE CAST ALLOYS
LEAD — SOLDERS — ZINC — ALLOYS

CONSUMERS

SCRAP METALS — BYPRODUCTS — RESIDUES

HYMAN VIENER & SONS
RICHMOND, VA.

WASHINGTON, D. C. *CHARLES TOWN, W. VA.*

Grundy and

PATTERNS

Svenson

★

WOOD AND METAL

MACHINE
TEXTILE
MARINE

Match Plates
Production Patterns

SHOP FULLY SPRINKLED
S. W. Cor. Front St. & Olney Ave.
WA 4-6071
Philadelphia 20, Pa.

NEW LITERATURE

F100—A bulletin published by the Hanna Engineering Works gives specifications and operating data on all Hanna valves. The line consists of foot-operated and hand-operated valves for air and hydraulic lines, and speed control valves for use with air and hydraulic cylinders.

F101—Federated Metals Div., American Smelting & Refining Co., is periodically issuing booklets of information on characteristics, uses, performances and other features of their products in the non-ferrous field. Some of the publications obtainable deal with non-ferrous metals and alloys, test bars and aluminum casting alloys.

F102—What rototrol is, what it does and how it works is outlined in a 36-page booklet on automatic operation for electrical equipment produced by the Westinghouse Electric Corp. The booklet explains how rototrol regulates voltage, speed, current, power, speed and torque, power factor, and position, and provides stability control and current limiting. Photographs, schematic drawings and performance curves are used to describe rototrol applications in various fields. Seven pages of technical information are also included giving additional data on theory, design and operating principles of standard rototrols and several frequently-used modifications.

F103—"Silicone Notes" published by Dow Corning Corp., has released some data on a series of silicone oils numbered DC 710, DC 710G and DC 710R. The DC 710 type silicone oils have exceptional heat stability combined with high resistance to oxidation, freedom from gumming, water repellency, low volatility and high flash points. Detailed test results and physical properties of these silicone oils are contained in the preliminary data sheet A 20-1. Copies are available.

F104—Superior Magnesium Castings has published a booklet covering phases of magnesium machining and finishing. Entitled "Machining and Finishing Magnesium Castings," the topics covered include: tools, cutting fluids, distortion, finishing and decorative finishings.

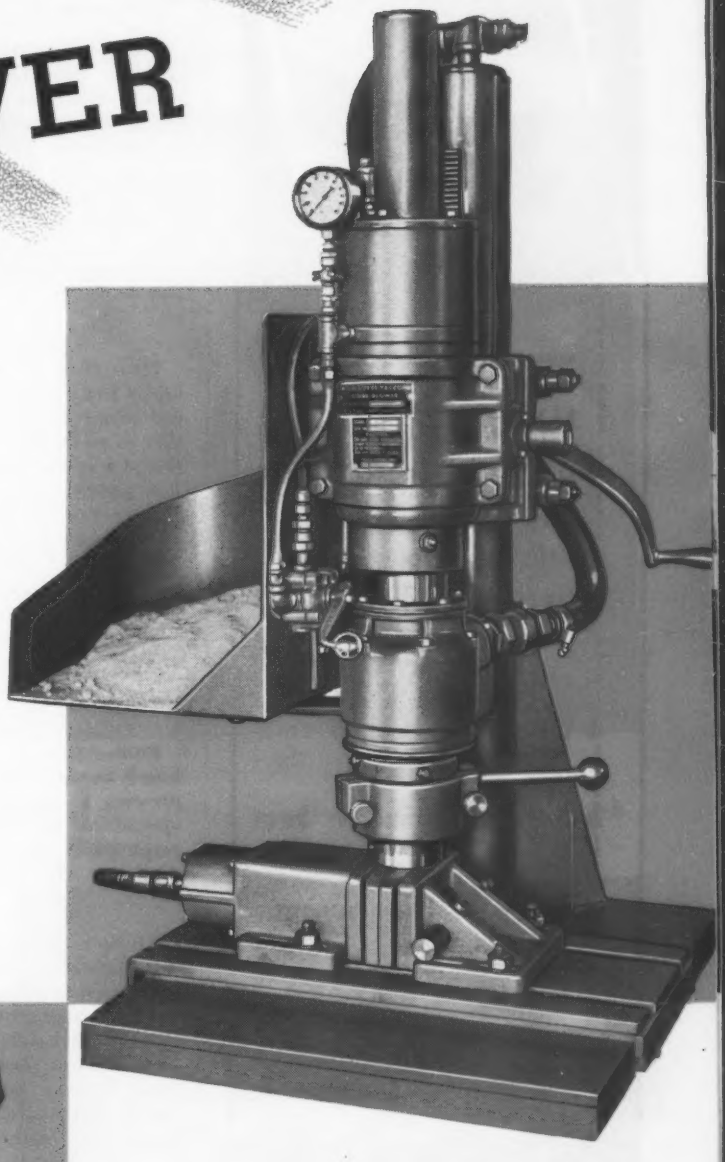
F105—Robins Conveyors Div., Hewitt-Robins Inc., has issued a bulletin completely describing and illustrating the Robins car shakeout. The bulletin not only presents the statements of the manufacturer—that the shakeout unloads a car in only a few minutes with only two men, and even unloads hopper-bottom cars which contain frozen materials

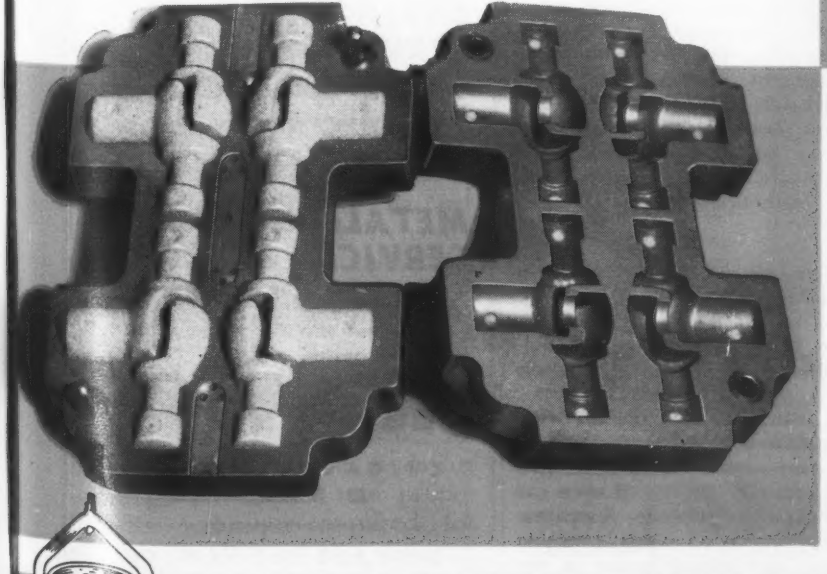
(*Concluded on Page 90*)

Blow Intricate Cores... *Faster with a* MILWAUKEE-TACCONE *Explosion Type* CORE BLOWER

You can blow more intricate cores and blow 'em faster with a Milwaukee-Taccone Bench Type Core Blower. An even, quick blast of air readily blows the most difficult cores. A pressure cylinder steps up the line pressure from 90 lbs. to 120 lbs. blowing pressure and assures steady pressure to produce quality cores. The powerful pneumatic vise and neoprene bonded plate provide a tight, fast blow.

The effortless operation of the quick opening valve and the explosion type blow enable the operator to blow cores as fast as they can be placed into position and removed. The synchronized action of clamping and blowing the core simultaneously, provides greater speed and a high degree of efficiency. Once the core is blown it is automatically released for removal by the operator.





A Sturdy, Precision-Built Machine, for Long Trouble-free Service

The Milwaukee-Taccone Core Blower will blow either horizontal or vertical split cores. It blows cores up to 3 lbs. in size. The moderate purchase price and low maintenance cost make it a desirable machine for foundries of all sizes.

MILWAUKEE *Foundry Equipment Co.*

3238 W. PIERCE STREET, MILWAUKEE 4, WISCONSIN, U.S.A.

THIS LITTLE BOOK MAY SAVE YOU BIG PRODUCTION MONEY!

- Tells how you can save from 10¢ to 20¢ a pound on high speed steels and get better results!
- Gives actual shop tests and comparisons!
- Practical data on heat treatment!
- Tells you how manufacturers are cutting production costs!

MOLYBDIC OXIDE — BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE" • CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

Climax Molybdenum Company
500 Fifth Avenue • New York City

MAIL COUPON TODAY!

CLIMAX MOLYBDENUM COMPANY AF-2
500 Fifth Avenue, New York 18, N. Y.

Please send me a copy of your free booklet

Name.....

Company.....

Address.....

NEW LITERATURE

(Continued from Page 88)

—but offers substantiating evidence in the form of reports from owners of the equipment relating their savings in unloading such substances as coal, coke, limestone and other bulk materials. Two pages are devoted to proof of the statement that the "car shakeout can be handled by any hoist that is able to lift a 5-ton load," the proof consisting of a spread of photographs showing rigs, some of them quite elaborate.

F106—A four-page, two color bulletin entitled "Blueprint for Tramp Iron Removal" describes and explains the many pieces of magnetic equipment designed for industrial processing lines produced by the Eriez Co. Specific applications and the magnetic equipment necessary to do the job are fully discussed. Pertinent data and engineering drawings showing size, weight and construction of units are also included.

F107—How certain specialized acid inhibitors and neutralizing materials promote cost-savings and improved-quality production in pickling iron and steel, is the subject of a special, illustrated Service Report just published by Oakite Products, Inc. A feature of this report is a special section containing graphs showing the action of these Oakite acid pickling inhibitors in reducing metal loss. A comparison chart and table show how these materials reduce acid consumption and extend life of pickling solutions by lowering iron sulphate build-up.

F108—"The Story of ABC" recently released by the Alabama By-Products Corp., presents a comprehensive picture of the operations, facilities and policies of the corporation and its wholly owned subsidiary the ABC Coal & Coke Co.

F109—A 12-page article on "Torch Brazing Aluminum" has been prepared by Air Reduction Sales Co. The article, illustrated with photographs and descriptive diagrams, covers such topics as the advantages of aluminum brazing; types of aluminum, strength and corrosion resistance, filler metals and fluxes, cleaning procedure and production torch brazing.

F110—A bulletin has been released by the Wheelco Instruments Co. Design, operating and specification data pertaining to the new Wheelco capacilog, "an electronic scriber" are contained in this two color, eight page informative bulletin. Measuring, indicating, recording and controlling functions are fully explained with principal components clearly illustrated and defined through the use of open cut photographs and line drawings. A separate price list covering terms of sale, available chart ranges, and current prices of the various models and accessory items is included.

HIGH SILICON IRON

JISCO

SILVERY

The choice of Foundries who demand the best.

"Jisco" Silvery is a "must" in the modern foundry. Its use means better castings at lower cost. It supplies the needed silicon.

Full information upon request.

- VIRGIN ORES
- LADLE MIXED
- MACHINE CAST

THE **JACKSON IRON & STEEL CO.**
JACKSON, OHIO

CHARLES C. KAWIN CO.

ANALYTICAL SERVICE

Chemical and Physical Tests of all Ferrous and Non-ferrous metals

ENGINEERING SERVICE

Consulting and Advisory Metallurgical and Foundry Engineering

METALLOGRAPHIC SERVICE

Photomicrographs, Grain Size, etc. on all Ferrous and Non-ferrous Metals

KAWIN

CHICAGO 5, ILLINOIS
431 S. Dearborn Street

BUFFALO 2, NEW YORK
110 Pearl Street

CHAPTER ACTIVITIES

(*Continued from Page 77*)

types of castings, and outlined by charts and drawings good practices to follow using tested emperical formulas.

Dr. Richard A. Flinn, American Brake Shoe Co., Mahwah, N.J., and A.F.A. Simpson gold medallist, served as technical chairman.

Despite the "blizzard of '47" that blanketed the Metropolitan area, approximately 75 members attended the meeting.

Detroit

C. J. Rittinger
American Car & Foundry Co.
Publicity Chairman

EXPLAINING THE manner in which the Nuremberg trials were held and grouped, Lt. Col. W. C. Baldwin, attorney for the United States government at Nuremberg, gave a highly interesting coffee talk at the January 15 meeting.

Following the talk, the members and guests broke up into three groups for sectional meetings. In the gray iron meeting F. J. Walls, International Nickel Co., Detroit, presented a talk on gray iron carbon control in the cupola under present conditions. Acting as discussion leader was E. J. Coon, foundry metallurgist, Packard Motor Co., Detroit.

Match Plates in Plaster

"Facts and Theory of the Pattern Industry" was described by E. J. Kindt, Kindt-Collins Co., Cleveland, to the pattern men. In addition to his talk a motion picture was shown which illustrated how cast aluminum match plates are made in plaster.

Leading the discussion was E. J. Rousseau, Commerce Pattern Foundry & Machine Co., Detroit.

The steel session had on hand H. J. Williams, New Jersey Silica Sand Co., Millville, N.J., who discussed the "Mining and Preparation of Molding Sands." The talk was illustrated with motion picture and slides of the many factors which influence the behavior of sands for molding. He showed the proper foundry technique required for skillful blending of the different materials to obtain a composition and texture that will meet the requirements of moldability, strength, permeability and surface finish. Aiding the question and answer period was F. S. Brewster, Harry W. Dietert Co., Detroit.

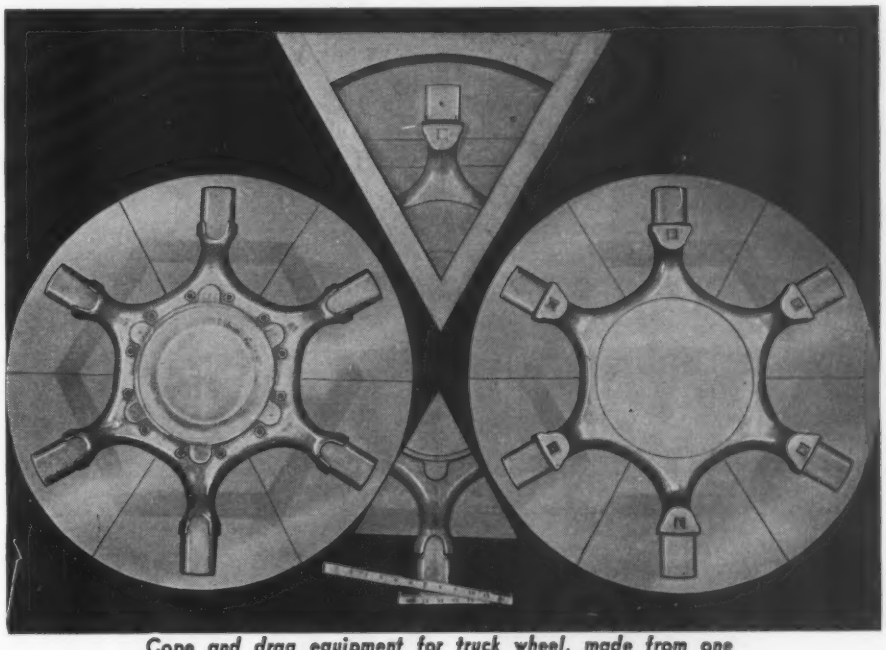
Ohio State

Eldon Boner
Secretary-Treasurer

THE OHIO State Student Chapter of the American Foundrymen's Association was installed January 13 at a meeting in the Industrial Engineering Department of Ohio State University, Columbus. The installation was preceded by an inspection of the foundry laboratory and a dinner at the faculty club.

Third student chapter to be approved by the A.F.A. Board of Directors, the Ohio State group was officially installed when A.F.A. Secretary-Treasurer Wm. W. Maloney passed the cast iron rattle symbolic

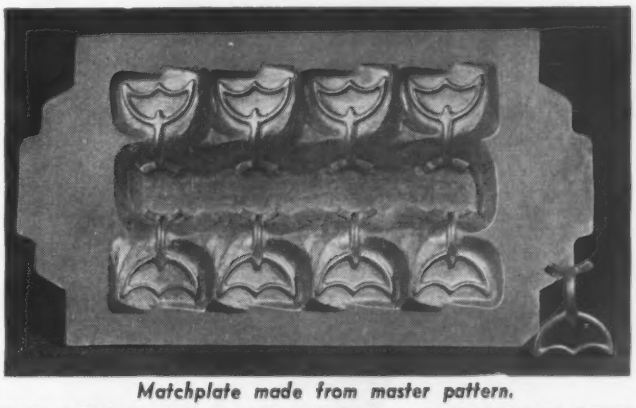
(*Continued on Page 93*)



Cope and drag equipment for truck wheel, made from one spoke (1/6) of wheel. Courtesy Erie Malleable Iron Company.

Pressure Cast Matchplates, Cope and Drag Plates Increase Your Production and Cut Your Cost

Only one master pattern does it! From it we make you single or multiple pattern matchplates, casting them under pressure in plaster molds. Why not find out exactly how much we can save you by this method, or by furnishing cope and drag plates which likewise jump production and lower your costs? Write us for quotations now.



Matchplate made from master pattern.

PLASTER PROCESS CASTINGS COMPANY
6926 Carnegie Avenue **Cleveland 3, Ohio**

(Toledo Matchplate Company, Toledo 2, Ohio - Affiliated)

Pressure-Cast MATCHPLATES
COPE and DRAG PLATES

THERE'S MORE TO A BUCKET THAN BITE

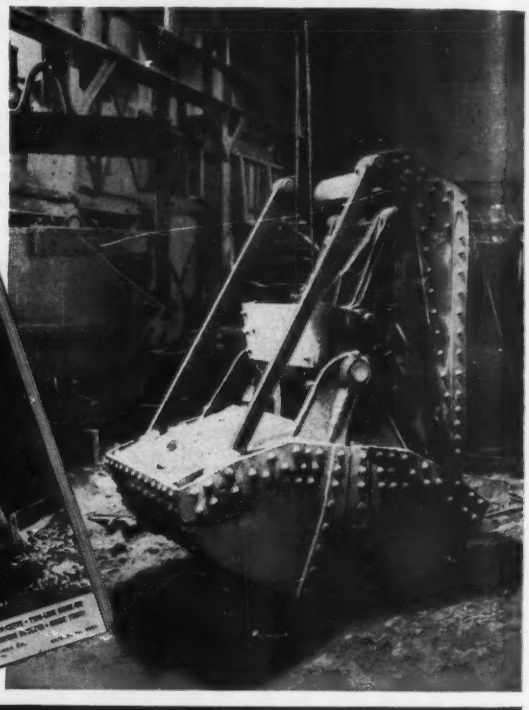
The Foundryman considers:

1. Character of materials handled
2. Quantities to be moved per hour
3. Type of hoist or crane available
4. Headroom and space limitations

Then he refers to the Blaw-Knox Bucket Catalogue. With the help of condensed tables of sizes and capacities, detailed descriptions of many types available, and a wealth of pictures and drawings, he is able to pick exactly the bucket that meets his specifications—his ideas of what he needs.

Blaw-Knox builds buckets to meet exacting needs.

BLAW-KNOX DIVISION
OF BLAW-KNOX COMPANY
2073 Farmers Bank Bldg., Pittsburgh 22, Pa.



SEND for Catalog No. 2002

BLAW-KNOX CLAMSHELL BUCKETS

Cast Metals Handbook

List Price $6; $4 to A.F.A. Members . . .

Order a Copy Today

The Accepted Standard Reference Book for All CAST METALS

The complete, accurate and up-to-date reference book on the Engineering Properties of ALL Cast Metals should be among the technical books in every Foundry. Outstanding metallurgists and competent men of industry contributed to it. Committees of technical men helped compile it, from the engineering standpoint.

Separate sections deal with all the Cast Metals and include extensive data on engineering properties, specific applications, factors in good castings design, and many other factors essential to a knowledge of the design production and performance of metal products.

For post-war products, the Cast Metals Handbook is a dependable reference work of interest to foundrymen, engineers, and all those interested in the development of better metal products.

3rd edition, completely revised. Cloth bound, 745 pages, 258 illustrations, 204 tables, extensive bibliographies and cross-index.

American Foundrymen's Association

222 West Adams Street Chicago 6, Illinois

CHAPTER ACTIVITIES

(Continued from Page 91)

of new chapterhood to Student Chapter Chairman William Dundon.

Inspection of the Ohio State foundry laboratory included a survey of existing facilities, an informal talk on new equipment not yet installed, an explanation of plans for a new foundry layout and a view of the room being refinished for a foundry control laboratory.

The present cupola is expected to be supplemented with another so that melting can be done conveniently on consecutive days. Other melting units include an electric furnace recently received by the university and a crucible furnace for melting non-ferrous alloys. Molding machines are being relocated so they can be serviced by a roll conveyor leading to a pouring station in front of the cupolas. Special casting methods are provided for by a centrifugal casting machine and a permanent mold. Investment casting is also planned. The core room includes space for bench coremaking and will shortly include a renovated coreblower. Cores are baked in a drawer type oven.

College Dean Speaks

The installation program was opened by Dr. D. C. Williams, professor of industrial engineering at Ohio State, who was formerly A.F.A. research fellow at Cornell University, Ithaca, N.Y. A faculty advisor to the student group, he outlined the program for the evening briefly and introduced Student Chapter Chairman Dundon who acted as master of ceremonies. Charles E. MacQuigg, dean of the engineering college and director of the engineering experiment station, Ohio State University, welcomed the group and forecast an interesting future for the students in foundry education and in the foundry industry.

A. F. A. Vice-President W. B. Wallis, president, Pittsburgh Lectromelt Furnace Corp., Pittsburgh, Pa., greeted the members of the new chapter on behalf of the American Foundrymen's Association. Following formal installation by Mr. Maloney, H. F. Scobie of the Association's headquarters staff cited the names and present foundry work of former members of the first student

(Concluded on Page 95)

OTTAWA SILICA CO. offers . . .

WASHED
DRIED
SCREENED
GRADED
WHITE SANDS

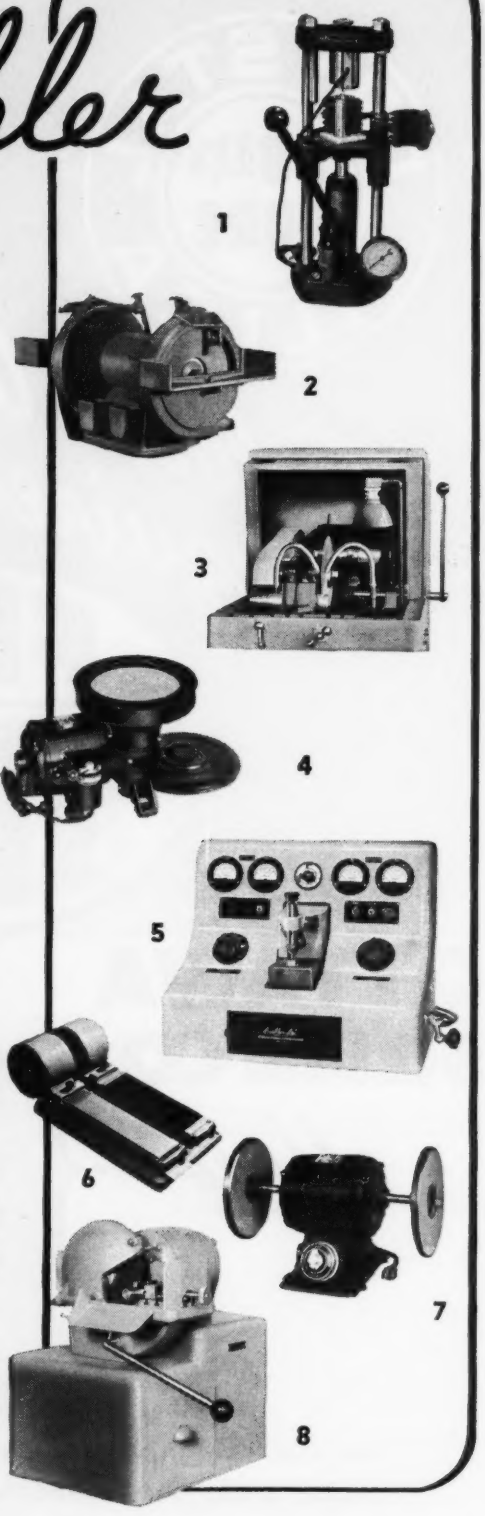
Our specially prepared SILICA SANDS are available in various sizes. We have the particular grade best suited for your requirements. ¶ You will find our SANDS most suitable for cores —they save oil—they are clean, uniform and constant in quality. ¶ SILICA FLOUR, at its best, for foundry uses.

OTTAWA SILICA COMPANY
Ottawa, Illinois

Buehler

Offers a Complete Line of Equipment for the . . . METALLURGICAL LABORATORY

Buehler specimen preparation equipment is designed especially for the metallurgist, and is built with a high degree of precision and accuracy for the fast production of the finest quality of metallurgical specimens.



1. No. 1315 Press for the rapid moulding of specimen mounts, either bakelite or transparent plastic. Heating element can be raised and cooling blocks swung into position without releasing pressure on the mold.

2. No. 1210 Wet power grinder with ¾" hp. ball bearing motor totally enclosed. Has two 12" wheels mounted on metal plates for coarse and medium grinding.

3. No. 1000 Cut-off machine is a heavy duty cutter for stock up to 3½". Powered with a 3 hp. totally enclosed motor with cut-off wheel, 12" x 3/32" x 1-1/4".

4. 1505-2AB Low Speed Polisher complete with 8" balanced bronze polishing disc. Mounted to ¼ hp. ball bearing, two speed motor, with right angle gear reduction for 161 and 246 R.P.M. spindle speeds.

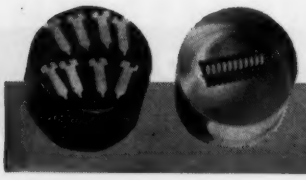
5. No. 1700 New Buehler-Waisman Electro Polisher produces scratch-free specimens in a fraction of the time usually required for polishing. Speed with dependable results is obtained with both ferrous and non-ferrous samples. Simple to operate—does not require an expert technician to produce good specimens.

6. No 1410 Hand Grinder conveniently arranged for two stage grinding with medium and fine emery paper on twin grinding surfaces. A reserve supply of 150 ft. of abrasive paper is contained in rolls and can be quickly drawn into position for use.

7. No. 1400 Emery paper disc grinder. Four grades of abrasive paper are provided for grinding on the four sides of discs, 8" in diameter. Motor 1/3 hp. with two speeds, 575 and 1150 R.P.M.

8. No. 1015 Cut-off machine for table mounting with separate unit recirculating cooling system No. 1016. Motor 1 hp. with capacity for cutting 1" stock.

The Buehler Line of Specimen Preparation Equipment includes . . . Cut-off Machines • Specimen Mount Presses • Power Grinders • Emery Paper Grinders • Hand Grinders • Belt Surfacers • Mechanical and Electro Polishers • Polishing Cloths • Polishing Abrasives.



Buehler Ltd.

A PARTNERSHIP

METALLURGICAL APPARATUS

165 WEST WACKER DRIVE, CHICAGO 1, ILLINOIS

Index to Advertisers

Ajax Metal Co.	96
Alter Co.	86
American Air Filter Co., Inc.	18
Baroid Sales Div., National Lead Co.	88
Beardsley & Piper Co.	83
Blaw-Knox Co.	92
Buehler, Ltd.	94
Cleveland Flux Co.	6
Climax Molybdenum Co.	90
Crucible Manufacturers Association	87
Dayton Oil Co.	95
Delta Oil Products Co.	12
Dougherty Lumber Co.	82
Eastman Kodak Co.	85
Electro Metallurgical Co.	17
Engineering Service, Inc.	86
Federal Foundry Supply Co.	1, 10-11
Federated Metals Div., American Smelting & Refining Co.	20
Fisher Furnaces, Div. of Lindberg Engineering Co.	13
Grundy & Svenson	88
International Nickel Co.	14
Jackson Iron & Steel Co.	90
Kawin, Chas. C., Co.	90
Keokuk Electro-Metals Co.	7
Kirk & Blum Mfg. Co.	2
Knight, Lester B., & Associates, Inc.	16
Krause, Chas. A., Milling Co.	15
Milwaukee Foundry Equipment Co.	89
Modern Equipment Co.	Cover IV
Oliver Machinery Co.	95
Onox, Inc.	86
Ottawa Silica Co.	93
Pittsburgh Lectromelt Furnace Corp.	Cover II
Plaster Process Castings Co.	91
Schneible, Claude B., Co.	4-5
Scientific Cast Products Corp.	84
Semet-Solvay Div., Allied Chemical & Die Corp.	80
Smith, Werner G., Co.	Cover III
Stevens, Frederic B., Inc.	19
Swan-Finch Oil Corp.	81
U. S. Hoffman Machinery Corp.	80
Viener, Hyman, & Sons	88
Wheland Co.	84